ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

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FEATURES IN THIS ISSUE

News of the Week..... 69

Editorials..... 78

Prefabricated Sections for Rotterdam Tunnel..... 80

Effective Use of Rivets and Bolts.....F. H. FRANKLAND 85

Detroit Plans Airport Development..... 88

Ventilating Equipment for Hoosac Tunnel..... 90

Cable Stiffened Suspension Bridge.....W. G. GROVE 91

Navigation on the Tennessee River—Part II.....C. T. BARKER 95

Slow Sand Filters Remove Colloidal Turbidity..... 99

New Responsibilities Discussed by Highway Officials..... 102

Nomograph for Circular Conduit Flow.....F. T. MAVIS 105

Trigonometric Leveling Using a Transit.....O. B. MISZ 106

DEPARTMENTS

New Construction	65	Unit Prices	120
Construction Scoreboard	67	New Aids to Constructor	122
From Field and Office	108	Elections and Activities	128
Comment and Discussion	109	Manufacturers Activities	133
Book Notes and Reviews	111	Men and Jobs	144
Material Prices	114	Manufacturers' Publications	148

Construction Reports 205

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Construction Trends

$1,155,000,000 Backlog Bridge Construction

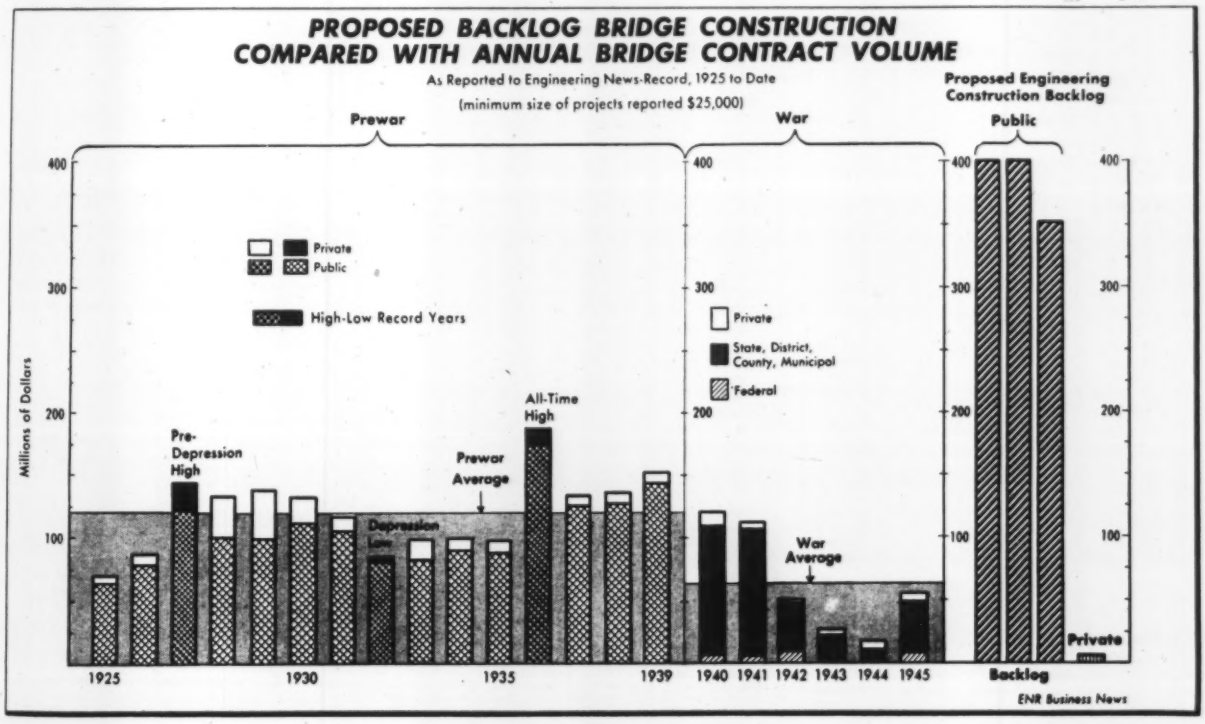
The cumulative proposed engineering bridge construction backlog on record with *Engineering News-Record* currently totals $1,154,757,000. This total could provide six years of bridge construction volume at the all-time high rate recorded in 1936, and ten years at the average recorded rate from 1925 to 1940.

Of this proposed bridge construction backlog 99.7 percent is made up of public construction—by states, counties, municipalities, authorities and international commissions; while the remaining .3 percent is for private bridge construction—mainly railroad bridges.

Bridge construction volume before the war varied from a 1936 high of $188 millions to a 1925 low of $70 millions. During the war bridge construction volume dropped steadily from $120 millions in 1940 to the all-time low of $17 millions in 1944. In the first three-quarters of 1945 the weekly average for bridge construction was $500,000. With the war over the last quarter of 1945 recorded the weekly average at $1,250,000. At present at the end of nine weeks of 1946 the weekly average is $1,810,000—indicative of what bridge construction volume may do in 1946.

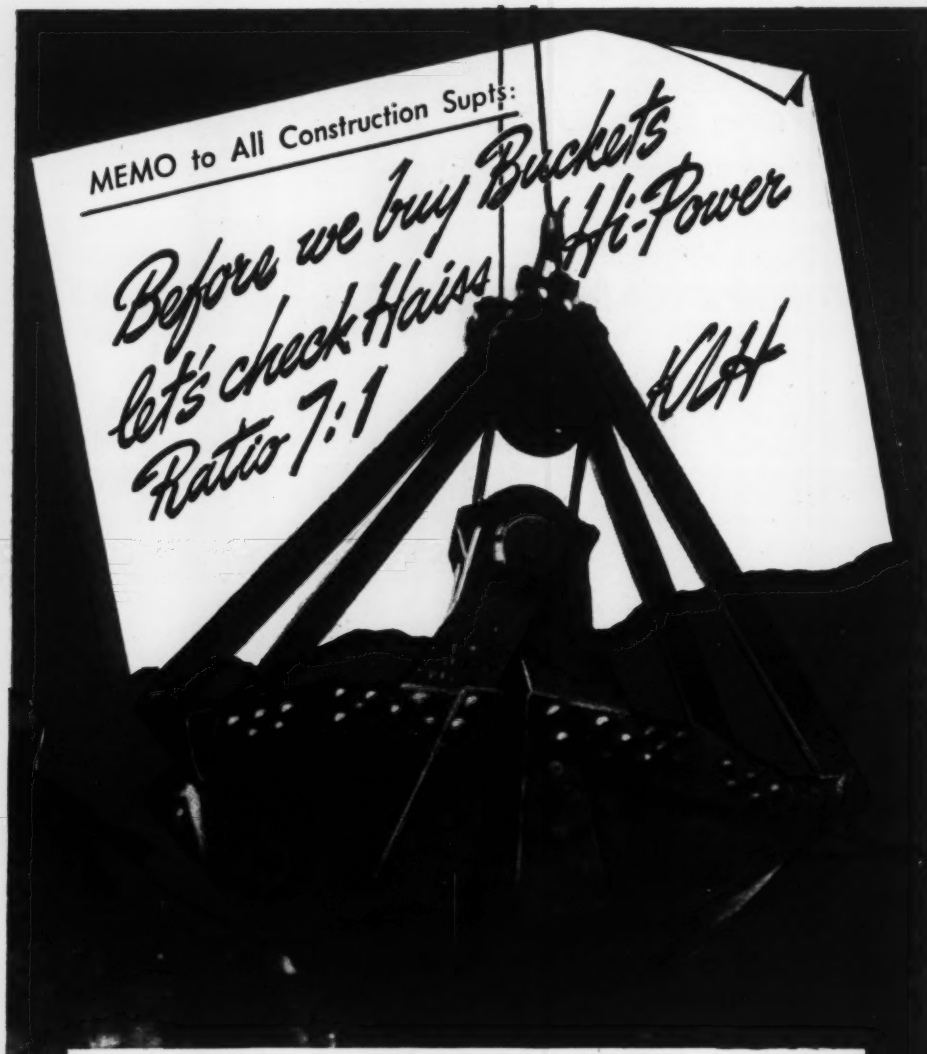
Of this $1,154,757,000 backlog for bridge construction Middle Western states make up 30 percent and Middle Atlantic states, 29 percent. States West of the Mississippi form 16 percent, and Far Western states 12 percent. Trailing the other sections are the Southern states, 8 percent and New England, 5 percent.

Using the 1940 census, the total proposed construction backlog for all classes of construction records a $219.00 volume per capita in the United States; of this per capita volume $8.74 is for bridge construction. Regional leaders on a per capita basis are Middle West, $12.89; Far West, $12.05; and Middle Atlantic, $11.00. States West of the Mississippi have a per capita volume of $7.02; New England, $6.24 and South $3.42.



MEMO to All Construction Supts:

Before we buy Buckets let's check Haiss Hi-Power Ratio 7:1



Among Buckets, Haiss Hi-Power excels through a time-tested combination of many superior features.

Weight distribution, for instance, is so concentrated that the bucket jaws carry downward to bury the entire bowl to insure the biggest possible payload.

Similarly, when the Haiss Hi-Power tackles a stuck-fast boulder it "grabs tight" to shake and tug until it's loose and "hoist away".

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HIGHEST CLOSING RATIO (up to 7:1)

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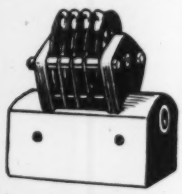

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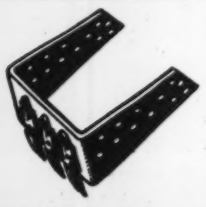


HEAVIEST JAWS OF ANY BUCKET OF ITS KIND

Abrasion resistant alloy. Will stand heavy battering and still hold shape. Chisel-point or pick-point teeth of similar extra strength.

New Construction in February

Total volume for month is $248,025,000. Private and State and Municipal construction below previous month but well above February 1945 total.

Civil engineering construction volume in the continental United States totals $248,025,000 for February, an average of $62,006,000 for each of the four weeks of the month. This average is 11 percent below the average for the five weeks of January, and is 126 percent above the average of the four weeks of February 1945.

Private construction for February on a weekly average basis is 11 percent below last month, but 490 percent greater than February 1945. Public construction is 10 percent below last month and 2 percent below the month last year. State and municipal construction while 6 percent below last month is 432 percent above the average for February 1945. Federal construction down 17 percent from last month is also down 63 percent below the 1945 month.

February 1946, weekly averages in the various classes of construction compared with last month reveal gains in sewerage, 64 percent; unclassified, 51 percent; public buildings, 24 percent; waterworks, 2 percent and highways, 1 percent. Losses were reported for earthwork and waterways, 59 percent; bridges, 25 percent; commercial buildings, 18 percent; industrial buildings, 14 percent.

Geographically, only two of the six sections recorded gains on a weekly average basis in February over the preceeding month of January. Middle West rose 51 percent and West of the Mississippi 31 percent. Those regions recording losses were Far West, 43 percent; New England, 35 percent; South, 17 percent; Middle Atlantic, 16 percent.

All sections recorded strong gains in February 1946 over February 1945 as follows: New England, 1,549 percent; Middle West, 226 percent; Middle Atlantic, 117 percent; West of Mississippi, 166 percent; Far West, 81 percent; South, 17 percent.

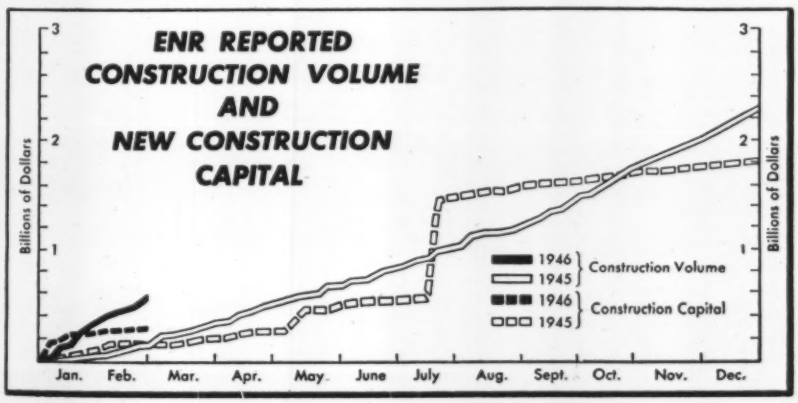
New capital for construction purposes for the four weeks of February, 1946 totals $39,536,000, or a weekly average of $9,884,000 that is 52 percent below the average for January 1946 and 57 percent below the average for February 1945.

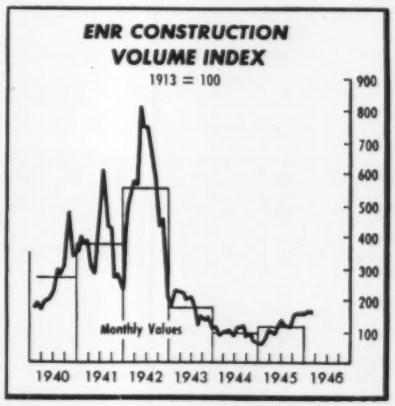
ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD—FEBRUARY, 1946

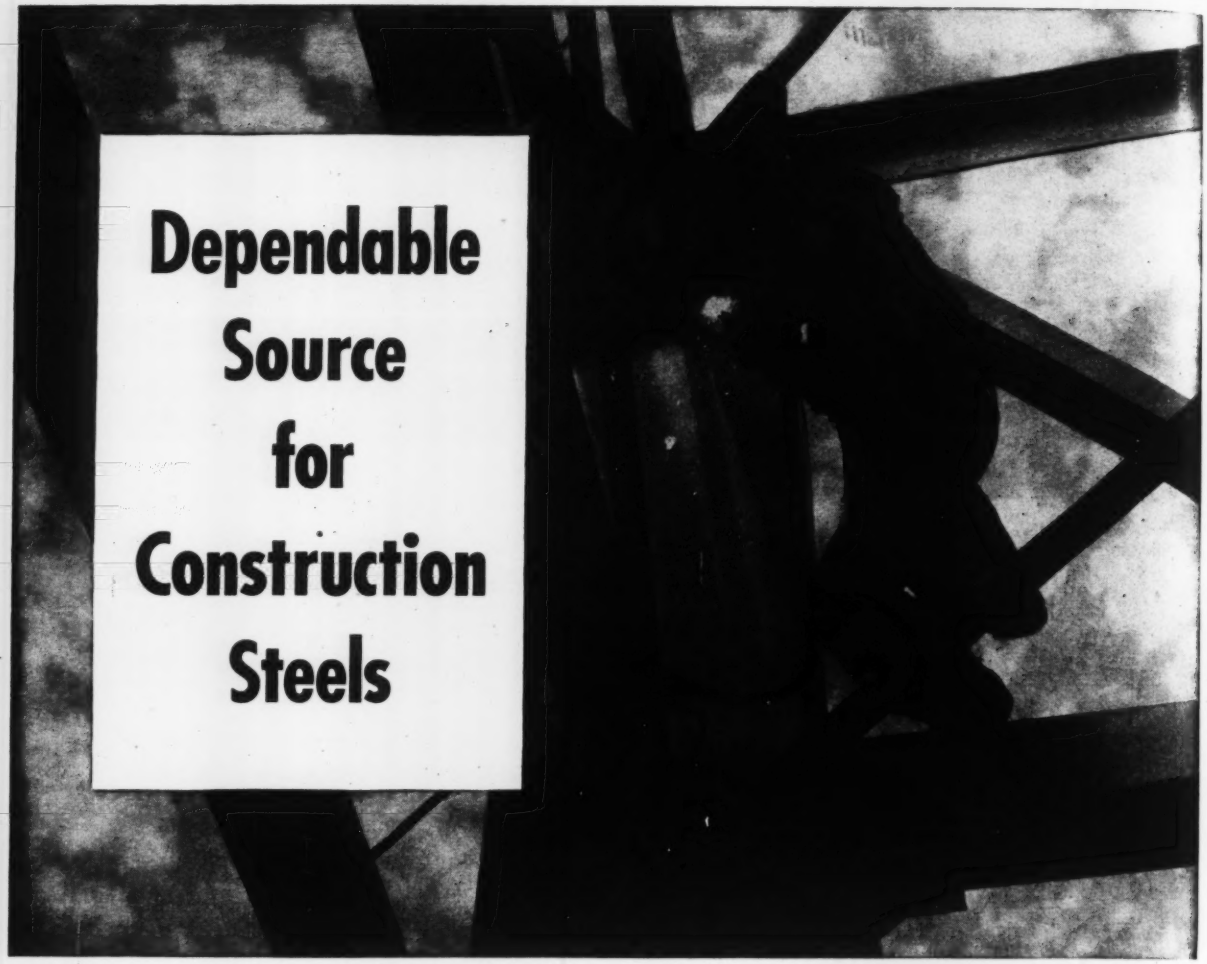
Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs — waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States [February 1946	United States Two Months 1946	United States Two Months 1945	Canada
Public Works										
Waterworks	88	237	496	566	2,317	600	4,304	9,602	6,189	452
Sewerage	530	68	156	509	797	1,147	3,207	5,660	6,273	518
Bridges, public	35	1,671	1,015	757	2,127	475	6,080	15,214	3,329	.....
Earthwork and waterways	527	413	452	.....	5,644	2,034	9,070	36,909	3,691	281
Streets and roads	196	1,594	7,974	2,397	14,407	2,384	28,952	64,908	10,057	1,991
Buildings, public	1,930	5,520	4,378	2,499	2,820	5,252	22,399	44,916	77,337	7,755
Unclassified, public	9	1,026	1,851	763	279	1,455	5,383	13,000	29,897	710
Total public	**3,315**	**10,529**	**16,322**	**7,491**	**28,391**	**13,347**	**79,395**	**190,209**	**136,773**	**11,617**
Federal government (included in above classifications)	555	6,548	2,951	350	6,524	9,545	26,473	66,646	112,116	.....
Private										
Bridges, private	.....	.....	.....	40	.....	.....	40	1,065	2,500	.....
Industrial buildings	2,633	5,275	7,114	30,887	17,351	10,523	73,783	180,577	39,584	11,725
Commercial buildings	13,219	26,994	1,656	4,355	8,811	22,143	77,178	195,380	13,630	4,655
Unclassified, private	88	175	2,987	1,742	10,578	2,059	17,629	29,071	5,222	1,792
Total private	**15,940**	**32,444**	**11,757**	**37,024**	**36,740**	**34,725**	**168,630**	**406,093**	**60,936**	**18,172**
Total Engineering Construction:										
February, 1946 — 4 weeks	**19,255**	**42,973**	**28,079**	**44,515**	**65,131**	**48,072**	**248,025**	.....	.....	**29,789**
January, 1946 — 5 weeks	37,090	63,908	42,463	36,743	61,920	106,153	348,277	.....	.....	24,263
February, 1945 — 4 weeks	1,167	19,787	23,934	13,623	24,497	26,508	109,516	.....	.....	2,619
Two Months — 1946	**56,345**	**106,881**	**70,542**	**81,258**	**127,051**	**154,225**	.....	**596,302**	.....	**54,052**
Two Months — 1945	4,065	29,693	38,522	23,798	47,930	53,701	.....	.....	197,709	7,706







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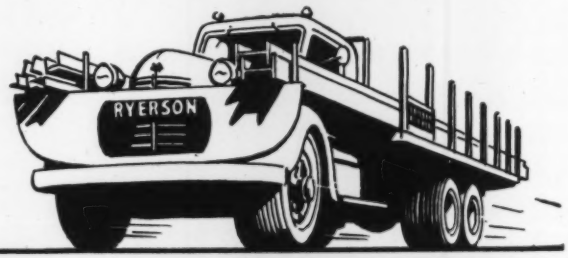
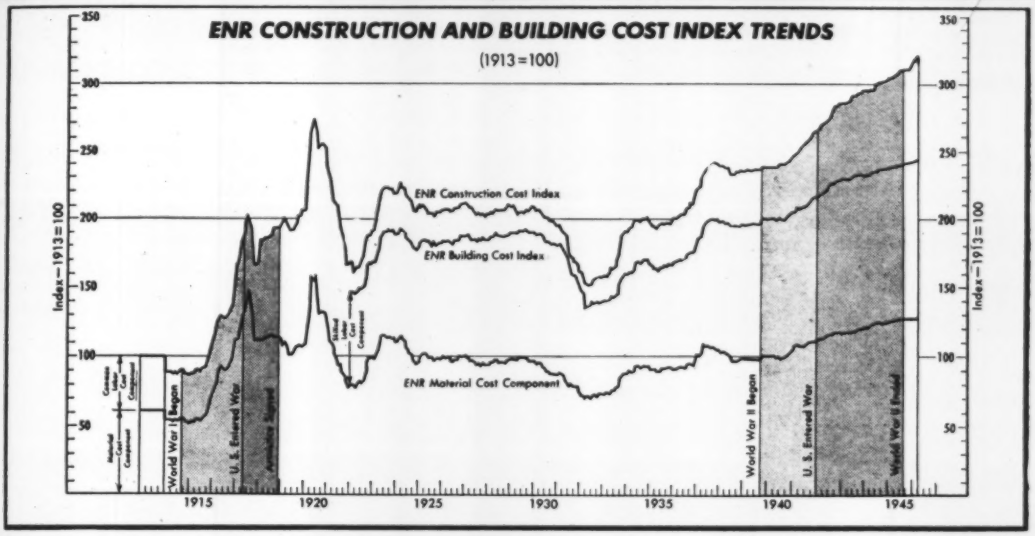


RYERSON STEEL

MARCH CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

(,000 omitted)	February 1945	February 1946	% Change	Two Months 1945	Two Months 1946	% Change
Total U. S. Construction	$109,516	$248,025	+126	$197,709	$596,302	+201
Private Construction	28,574	168,630	+490	60,936	406,093	+566
Public Construction	80,942	79,395	−2	136,773	190,209	+39
Federal	70,995	26,473	−63	112,116	66,646	−41
Total New Productive Capital	93,255	39,536	−58	196,472	143,333	−27
Private Investment	93,255	39,536	−58	119,335	143,333	+20
Federal (non-federal work)	.....	.....	.....	.....	.....	.....
Federal (federal work)	.....	.....	.....	77,137	158,320	+105
E N R Construction Volume Index 1913 = 100	78	167	+114	71*	178*	+151

* *Two-month average.*

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Mar., 1946	323.83	155.66	245.41	132.66	...	...
Feb., 1946	319.52	153.59	243.94	131.86	167	73
Jan., 1946	316.32	152.05	242.23	130.94	189	83
Dec., 1945	313.48	150.69	240.82	130.18	163	71
Nov., 1945	309.28	148.67	240.55	130.00	173	76
Oct., 1945	309.28	148.67	240.35	129.93	167	73
Sept., 1945	309.28	148.67	240.07	129.77	164	72
Aug., 1945	309.08	148.57	239.94	129.70	119	52
July, 1945	308.99	148.53	239.64	129.54	119	52
June, 1945	308.99	148.53	239.37	129.40	133	58
May, 1945	307.43	147.78	238.46	128.90	93	41
April, 1945	306.43	147.30	238.46	128.90	99	43
Mar., 1945	304.50	146.37	237.85	128.57	103	45
Feb., 1945	303.70	145.99	237.71	128.50	78	34
1945 (Av.)	307.74	147.93	239.14	129.27	123	54
1944 (Av.)	298.63	143.39	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77
1942 (Av.)	276.31	132.82	222.39	120.22	553	243

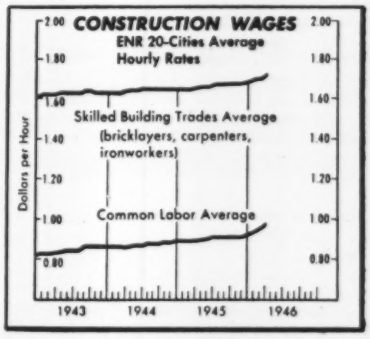
CONSTRUCTION COSTS . . . . WAGE RATES . . . . MATERIAL PRICES

	March 1945	March 1946	% Change	Change February to March 1945 Feb.	1945 Mar.	%	1946 Feb.	1946 Mar.	%
E N R Construction Cost Index, 1913 = 100	304.50	323.83	+6.3	303.70	304.50	+0.3	319.52	323.83	+1.4
E N R Building Cost Index, 1913 = 100†	237.85	245.41	+3.2	237.71	237.85	+0.1	243.94	245.41	+0.6

†*Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

	March 1945	March 1946	% Change	Change February to March 1945 Feb.	1945 Mar.	%	1946 Feb.	1946 Mar.	%
Common Labor	$0.895	$0.988	+10.4	$0.891	$0.895	+0.4	$0.968	$0.988	+2.1
Skilled Labor (Av. 3 Trades)	1.643	1.743	+6.1	1.641	1.643	+0.1	1.726	1.743	+1.0
Bricklayers	1.744	1.839	+5.5	1.739	1.744	+0.3	1.823	1.839	+1.0
Structural Ironworkers	1.698	1.771	+4.3	1.698	1.698	0.0	1.764	1.771	+0.4
Carpenters	1.487	1.618	+8.8	1.487	1.487	0.0	1.592	1.618	+1.6
Cement, per barrel	2.74	2.74	0.0	2.72	2.74	+0.7	2.74	2.74	0.0
Reinforcing steel, cwt.	2.79	2.79	0.0	2.79	2.79	0.0	2.79	2.79	0.0
Structural steel, base	2.10	2.10	0.0	2.10	2.10	0.0	2.10	2.10	0.0
Sand, per ton	1.25	1.25	0.0	1.25	1.25	0.0	1.25	1.25	0.0
Lumber, 2x4 Fir, per M ft.	55.32	55.66	+0.6	55.32	55.32	0.0	54.99	55.66	+1.2
Lumber, 2x4 Pine, per M ft.	53.44	54.46	+1.9	53.44	53.44	0.0	54.55	54.46	−0.1
Common brick, per M	18.32	20.33	+11.0	18.32	18.32	0.0	20.00	20.33	+1.6
Ready-mixed concrete, c.y.	7.57	.....	.....	7.48	7.57	+1.2	7.73	.....	.....
Struct. clay tile, 3x12x12	83.73	90.23	+7.7	83.00	83.73	+1.0	88.49	90.23	+2.0
Paving asphalt, cars, ton	15.48	15.07	−3.0	15.48	15.48	0.0	15.07	15.07	0.0

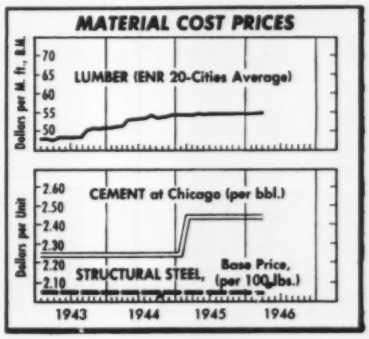


MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	February 1945	February 1946	% Change	Jan. 1946	% Change Jan.-Feb.
Steel (% operating capacity) A.I.S.I.	92.6	21.2	−77	42.2	−50

	January 1945	January 1946	% Change	12 Months 1944	12 Months 1945	% Change
Fabricated Structural Steel, tons, A.I.S.C.	37,004	108,048	+192	628,877	1,114,087	+77
Cement, thous. bbl., U. S. B. of M.	4,873	7,391	+ 52	94,060	108,926	+16

	January 1945	January 1946	% Change
Building Permits, 215 cities, Dun & Bradstreet (,000 omitted)	$44,767	$204,052	+356



COST OF LIVING INDEX . . . . CIVIL NON-AGRICULTURAL EMPLOYMENT

	January 1945	January 1946	% Change	Dec. 1945	% Change Nov.-Dec.
Cost of Living Index, N. I. C. B.	105.3	106.7	+1.3	106.7	0.0
Rent (Housing) Index, N. I. C. B.	91.0	91.0	0.0	91.0	0.0
Total Employment (est.), thous., B. L. S.	37,952	35,706	−6	36,339	−2
Constr. Employment (est.), thous., B. L. S.	582	1,095	+88	1,032	+6

Repair Work on dam of Western Massachusetts Electric Co. which had been exposed to 40 years of alternate freezing and thawing. H. A. Moody, Hydraulic Engineer; Daniel O'Connell's Sons, Inc., Holyoke, Mass., Contractors; Duraplastic ready-mixed concrete furnished by Construction Service Company, Springfield, Mass.

Repairs to 40-Year-Old Dam made with AIR-ENTRAINED CONCRETE

A hydro-electric station of the Western Massachusetts Electric Co. had been exposed to the rigor of 28 winters. To repair it the engineers specified Atlas Duraplastic air-entraining cement.

The resulting concrete was so satisfactory that the engineer again used Duraplastic cement to repair a dam that had been exposed to 40 New England winters.

He states that—

1. **Duraplastic cement was used to fortify the concrete against freezing and thawing weather.**
2. **With this cement there was practically no segregation or bleeding.**
3. **This cement so improved workability that the entire surface is free from stone pockets and sand streaks.**
4. **Such a surface probably will longer resist the abrasive action of overflowing water.**

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News of the Week

ENGINEERING NEWS-RECORD • MARCH 7, 1946 • VOLUME 136 • NUMBER 10

Cost of St. Lawrence project raised to over $455,000,000

Army Engineers give revised cost figures to Senate Committee considering seaway and power project—Shipping interests declare proposed 27-ft. channel too shallow

Revised estimates of the cost of the St. Lawrence seaway and power project were given to a subcommittee of the Senate Foreign Relations Committee on Feb. 20 by Lt. Gen. Raymond A. Wheeler, Chief of Engineers, and Maj. Gen. Thomas M. Robins. These estimates set the cost of completing the project at $455,086,000 as compared to $409,340,000 estimated in 1941 at the time the agreement between this country and Canada for completion of the project was signed but was not approved by Congress.

The committee that received the estimates is now considering legislation to give effect to the 1941 agreement.

The 1941 agreement was broad in its scope. In addition to work in the international section of the St. Lawrence River, that document called for construction of the MacArthur Lock at Sault Ste. Marie (subsequently built as a war measure), deepening of connecting channels of the Great Lakes to 27 ft., deepening of the Welland Canal to 27 ft., constructions of submerged weirs above Niagara Falls to redistribute the flow (also built as a war measure) and construction of new ship canals in the Soulanges and Lachine sections of the St. Lawrence River between the international section and Montreal (*ENR* May 22, 1941, vol. p. 824 and June 19, 1941, vol. p. 951).

Cost estimates revised

The total cost, including expenditures already made by Canada on the Welland Canal, was estimated in 1941 at $559,118,400, of which $409,340,000 represented new work. Under the 1941 agreement, about $277,000,000 of this was to be paid by the United States and $132,000,000 was chargeable to Canada.

Under the revised estimates, the required expenditures have been raised to $455,086,000 as shown in the accompanying table, or roughly about 10 percent.

It should be noted, however, that while this estimate increases the cost of MacArthur Lock from an estimated $8,000,000 to the actual cost of $14,637,000, it makes no increase in the cost of work in the connecting channels between the Great Lakes and no increases in estimated cost of work in the Canadian section of the St. Lawrence River.

Further, while the Army Engineer's estimates have been increased about 10 percent, actual bids on work now being let to contract average around 35 percent and many run as high as 50 percent.

During the past two weeks the Senate committee has heard both the proponents and opponents of the project. Little new information has been developed by the hearings other than the revised cost figures, given above, and a statement from the American Merchant Marine Institute of New York that due to the radical changes that occurred in this country's merchant fleet as a result of war losses and war shipbuilding, the proposed 27-ft. ship channel of the St. Lawrence and through the Great Lakes would be too shallow for more than 90 percent of the American merchant ships. This condition, shippers hold, would make it uneconomical for our ships to operate through the proposed seaway.

ESTIMATE OF COST OF THE ST. LAWRENCE SEAWAY AND POWER PROJECT

	Canada	United States	Totals
Great Lakes Section:			
New Lock at Sault Ste. Marie with approach channels	.....	$14,637,000	$14,637,000
Connecting Channels	.....	66,029,000	66,029,000
Welland Canal	$133,000,000	.....	133,000,000
St. Lawrence River:			
Thousand Island Section	772,000	991,000	1,763,000
International Rapids Section:			
A. Works solely for navigation	.....	42,964,000	42,964,000
B. Works primarily for power	38,344,000	98,684,000	137,028,000
C. Works common to navigation & power	22,414,000	118,711,000	141,125,000
Canadian Section:*			
St. Francis Lake Channel	1,330,000	.....	1,330,000
Soulanges Reach	25,785,000	.....	25,785,000
Lachine Reach	55,839,000	.....	55,839,000
Totals	$277,484,000	$342,016,000	$619,500,000
Expenditures to date	132,672,000	31,742,000	164,414,000
Cost to complete	$144,812,000	$310,274,000	$455,086,000

* Canadian estimates prepared in 1941.

House refuses subsidies for housing materials

By a vote of 161 to 92, the House of Representatives March 4 in debate on the Patman Housing Bill (H. R. 4761) turned down the proposal that the federal government provide $600,000,000 for use as subsidies to increase the output of new and conventional materials.

It had been proposed that the National Housing Director, which is a new position the bill would create, would be empowered to instruct the Reconstruction Finance Corp. to make payments to this extent. Defeat of the proposal has been declared by Administrator Wyatt of the National Housing Agency a major blow to his announced program of constructing a total of 2,700,000 homes for veterans this year and next (*ENR* Feb. 14, vol. p. 257).

In earlier debate on the bill the House also refused to provide the administration with the power to place ceilings on the selling prices of existing homes. This action has been declared another major setback for housing legislation.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Housing—Two housing developments in suburban *Philadelphia, Pa.*, call for expenditure of $8,000,000. The Breyer Corp. will put up a $1,000,000 project at *Bryn Mawr*, and Erny and Nolen will build a $7,000,000 project at *Plymouth Meeting*. . . . Housing Enterprises, Ltd., plans a $2,000,000 colony at *Halifax, N. S.* . . . A. P. Miller, Inc., plans a $3,000,000 development at *Somerville, N. J.* . . . *In Los Angeles, Calif.*, the transit company said that 350 retired streetcars will be converted into homes . . .D. C. Magen and Co. will build 300 homes, to cost about $2,100,000 at *Camden, N. J.*

Industrial building—Marshall Field and Co. plans a $5,000,000 program to enlarge its store at *Seattle, Wash.* . . . *Minneapolis, Minn.*, industrialists reported city plants will spend $12,450,000 on construction during 1946. . . . Sears, Roebuck and Co. will spend $807,500 on a new store at *Trenton, N. J.* . . . Construction has been resumed on a 16-story steel-frame office building for the Bank of Montreal in the heart of *Toronto, Canada.*

Highways—*Kansas* started condemnation proceedings in northeast *Kansas City, Kan.*, to make way for a new 4-lane highway entering the city. . . . *Florida* adopted a highway budget calling for expenditure of $39,000,000 for construction and maintenance. . . . *Cincinnati, Ohio*, outlined a $2,477,000 street repair program. . . . More than half of *Kentucky's* $54,000,000 roadbuilding program will be under way in 1946. . . . *East St. Louis, Mo.*, advertised for bids for construction of three concrete bridges over Schoenberger Creek, to cost $300,000. . . . *Alabama* awarded contracts on the last seven of 20 high priority 1946 highway projects.

Bond Issues—*Peoria, Ill.*, will vote April 9 on a $1,240,000 issue to finance a new city hall. . . . *Kinston, N. C.*, approved a $1,625,000 issue for water, street and sewer improvements. . . . *Seminole, Okla.*, voters approved a $211,000 school bond issue. . . . A $500,000 water and sewer issue has been voted at *Lexington, N. C.*

Water Supply—Projects in six western states, aggregating more than $3,000,000, are under way. Largest is a $1,000,000 job at *Spokane, Wash.*, where a 60 mgd. pumping station will be built. Others include *Denver, Colo.; Oakland* and *Alameda, Calif.; Salt Lake City, Roosevelt, Pleasant View, Ferron, Clearfield* and *Orem City, Utah; Alamogordo, N. M.*, and *White Sulphur Springs, Mont.* . . . *Savannah, Ga.*, city councilmen authorized issuance of $3,000,000 in bonds to finance a planned new water system. . . . *Macon, Ga.*, will spend $1,000,000 to accommodate incoming industrial firms.

Miscellany—The *Allegheny County, Pa.*, Sanitary Authority reported itself organized, but lacking the needed $200,000 in funds. . . . The *Missouri* Commission of Resources and Developments recommended that the proposed Osceola and South Grand Reservoirs be shelved for the present to make way for housing construction. . . . Consulting engineers for the Georgia Agricultural and Industrial Development Board estimated that construction of proposed terminal facilities for *Savannah* would cost in the neighborhood of $8,000,000. . . . Request for a complete water control study of the Kankakee River basin in *Indiana* has been submitted to Army engineers by Indiana Flood Control Commission.

Appoint research group for building industry

Following the recent Washington meeting of the Construction Industry Advisory Council. (*ENR*, Nov. 8 1945, vol. p. 621) a special committee on research has been organized under the chairmanship of Eric Johnston. It is developing a program for stimulating research in the building industry.

The committee, appointed by Advisory Council Chairman John Stevens, follows:

Fritz B. Burns, builder, Los Angeles; H. L. Dryden, assistant director, Bureau of Standards; James R. Edmunds, Jr., president of the American Institute of Architects, Baltimore; Frederick M. Feiker, dean, School of Engineering, George Washington University; Roy C. Ingersoll, president, Ingersoll Steel and Disc Division, Borg-Warner Corp. Chicago; R. G. Kimbell, National Lumber Manufacturers Association, Washington; W. A. Klinger, president, W. A. Klinger Co., Sioux City, Ia.; T. S. Rogers, Owens-Corning Fiberglas Corp., Toledo; E. O. Shreve, vice-president, General Electric Company, New York City; Harry H. Steidle, manager, Prefabricated Home Manufacturers Institute, Washington; and Carlile P. Winslow, director U. S. Forest Products Laboratory, Madison, Wis.

Calendar of Meetings

NATIONAL

American Shore and Beach Preservation Association, annual meeting, Hotel Carlton and National Academy-Research Council Building, Washington, D. C., March 21 and 22.

National Society of Professional Engineers, conference of state presidents of member state societies, and board of directors meeting, Deshler-Wallick Hotel, Columbus, Ohio, March 29-30.

American Concrete Pipe Association, 38th annual convention, Edgewater Beach Hotel, Chicago, Ill., April 11-12.

American Society of Civil Engineers, spring meeting, Bellevue Stratford Hotel, Philadelphia, Pa., April 17-19.

REGIONAL

Minnesota Section, American Water Works Association, Radisson Hotel, Minneapolis, Minn., March 14-15.

New Jersey Society of Professional Engineers, 1946 convention, Essex House, Newark, N. J., March 15-16.

Mississippi Valley Conference of State Highway Departments, annual meeting, Edgewater Beach Hotel, Chicago, Ill., March 15-16.

New England Section, American Water Works Association, Statler Hotel, Boston, Mass., March 21.

Indiana Section, American Water Works Association, Union Building, Purdue University, Lafayette, Ind., April 2-3.

Canadian Good Roads Association, annual convention, Chateau Frontenac, Quebec City, Canada, April 2-5.

Canadian Section, American Water Works Association, annual convention, General Brock Hotel, Niagara Falls, Ont., April 8-10.

Lumbermen's Association of Texas and Texas Lumber Manufacturers Association, 60th annual convention, Galveston, Texas, April 8-10.

Montana Sewage Works Association, Butte, Mont., April 11-12.

Montana Section, American Water Works Association, Finlen Hotel, Butte, Mont., April 12-13.

Arizona Sewage and Water Works Association, Tucson, Ariz., April 18-20.

Florida Engineering Society, 13th annual meeting, Jacksonville, Fla. April 25-27.

Charge U. S. Geological Survey competes with private interests in well drilling

Contractors' groups approve resolution condemning survey for "bureaucratic usurpation" of private functions—Seek fund cut

Bitter opposition to what many well-drilling and water supply contractors consider entrance of the U. S. Geological Survey into their business crystallized recently in a resolution that strongly condemned this federal agency for "bureaucratic usurpation of functions normally carried out successfully by private industry."

The resolution was a highlight of the 25th annual meeting of the Minnesota Well Drillers Association, held at Minneapolis Jan. 21 to 23, and carried with it an appeal to similar organizations to join in the formal protest. The group appointed Lee Rogers, president of the Layne-Western Co., Minneapolis, to represent it at Congressional hearings this week on the Geological Survey's request for funds.

The year-long controversy has its roots in the announcement in January, 1945 (*ENR* Jan. 11, 1945, vol. p. 17), that the U. S. Geological Survey planned a $15,000,000 postwar water program, which would include long-needed repairs to existing installations, more gaging stations and observation wells, and the establishment of laboratories to carry on investigations as to the quality and availability of domestic water supplies.

Well drillers reacted immediately to a portion of the Survey's published plans which forecast "increasing cooperation with states and municipalities" in checking availability and suitability of groundwater supplies.

Led in part by Mr. Rogers, who characterized this plan as ". . . particularly vicious and objectionable," the contractors cited numerous instances where they said engineers of the Geological Survey had done work for municipalities that would normally have been performed by engineers and contractors. They also accused the Survey's offer of its services as fostering the use of state-owned equipment and state-employed men in actively seeking such work, to the detriment of private interests.

In August, 1945, this protest prompted a direct query by *Engineering News-Record* to W. E. Wrather, director of the Survey, for a statement of his organization's activities and views on the subject.

Replying by letter, Mr. Wrather said that the original news story apparently had been misinterpreted, in that the Survey had asked no appropriation from Congress, but had merely made public its long-range plans, drawn up at the request of the Bureau of the Budget, for use if and when called for in the future.

"The Geological Survey has no intention of entering into competition with private industry, and in most cases, needed test-hole drilling can doubtless be accomplished with satisfactory results by means of contracts with well-drilling contractors," Mr. Wrather said.

"Where such arrangements are not possible, cooperatively-owned drilling equipment (such as the contractors charge has been purchased in several states, using Survey-matched funds) could be used advantageously to supplement private drilling," he added.

"The . . . Survey's interest in test drilling is . . . a means to an end . . . comparable to the installation of gaging-stations. It is not an item of Survey policy that . . . test holes be drilled by government or state-owned rigs; it is our duty, however, that such drilling . . . be done as economically and efficiently as possible. The Geological Survey will welcome the opportunity of carrying on its test drilling under mutually satisfactory agreements with private contractors equipped . . . with rigs . . . suited to the purpose."

Contractors have replied to this statement with the charge that the reply was "garbled" and that, despite protestations of innocent intent, the survey was continuing its work of competition with private enterprise.

Army engineers given first VA construction

The Veterans Administration Feb. 27 turned over hospital projects totalling $188,278,000 to the Corps of Engineers for construction, in the first en bloc assignment of VA construction following the recent announcement (*ENR* Feb. 21, vol. p. 265) that a large part of the VA program would be handled by the engineers.

Funds have already been appropriated by Congress for the 35 new hospitals and additions requiring new sites included in the list turned over to the engineers.

Biggest of the projects turned over to engineers are: Pittsburgh, Pa., $11,431,000; Metropolitan New York, $10,861,000; Buffalo, and Albany N. Y. and Newark, N. J., $10,400,000; Lebanon, Pa., $9,147,199, and Washington, D. C., $6,151,000.

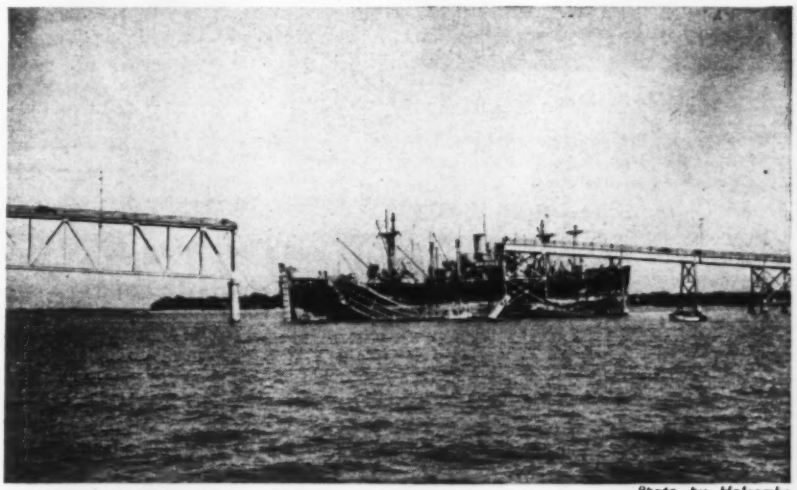


Photo by Holcombe

Drifting ship wrecks South Carolina bridge span

A 300 ft. break was torn in the 2-mi. long John P. Grace (Cooper River) bridge between Charleston and Mount Pleasant, S. C., recently, when the victory ship Nicaragua Victory dragged her anchor in a sudden gale and crashed into the span.

The South Carolina State Highway Department said it may take several months for repairs to be made. Meanwhile, traffic is being routed by way of Moncks Corner, about 50 miles away. Navy and Coast Guard boats are operating emergency ferry services.

Officials said that the vessel did not have steam up, and consequently was unable to avoid crashing into the bridge structure.

The bridge, purchased about a year ago by the state highway department, was to have been freed of tolls July 1.

J. A. Krug nominated as Interior Secretary

Former War Production Board head was also power expert for TVA

President Harry S. Truman on Feb. 26 announced that he had nominated Julius A. Krug, former chief of the War Production Board and once power engineer for the Tennessee Valley Authority, as Secretary of the Interior.

Mr. Krug would succeed Harold L. Ickes, who resigned recently. His appointment would be the second to a major post in the Interior Department of major interest to engineers. Late in December, the President appointed Michael W. Straus, former newspaper man, as Commissioner of the Bureau of Reclamation. (*ENR*—Dec. 20, 1945, vol. p. 832)

J. A. Krug

Although not a civil engineer (his degree from the University of Wisconsin was in Public Utilities management and economics), Mr. Krug, 38, has devoted much of his career to phases of power development.

After a period as public research analyst with the Wisconsin Telephone Co., he became chief of the business depreciation section of the Wisconsin Public Utilities Commission.

In 1935 he went to Washington as a public utility expert with the Federal Communications Commission, and shortly thereafter was placed in charge of all Kentucky state utilities by the then governor, A. B. Chandler.

He assisted in the establishment of the Tennessee Valley Authority and became chief power engineer of that agency, playing a leading role in the proceedings that led to its acquisition of the Tennessee properties of the Commonwealth & Southern Corporation. In the early days of the national emergency period, Mr. Krug left TVA to join the National Defense Advisory Commission, and later took over the job of steering the country's utilities industry for war under the Office of Production Management and its successor, WPB.

Early in 1943, Mr. Krug became vice chairman of the War Production Board, and after a short period of service as lieutenant commander in the Navy, he became head of the WPB in August, 1944.

With the recent liquidation of the War Production Board, and transfer of its duties to a successor agency, Mr. Krug retired from public life, and became an engineering consultant.

Chicago begins study for joint rail terminal

Engineering studies looking toward construction of a new railroad terminal to replace the four existing passenger stations south of the Chicago, Ill., Loop began in earnest recently when a terminal committee opened an engineer's office at 166 W. Jackson Boulevard.

The Terminal Committee, representing 16 railroads that would be involved in such a terminal, is headed by F. G. Gurley, president of the Atchison, Topeka & Santa Fe Railroad Co.

A new south side station—a dream of city planners for more than 20 years—would replace the present Grand Central, LaSalle Street, Dearborn and Illinois Central stations.

The survey will be conducted by C. P. Richardson, terminal engineer, under direction of R. E. Dougherty, vice president of the New York Central system and chairman of the Terminal Committee's engineering sub-committee.

To build berthing basin in Mare Island channel

Construction plans have been announced by the 12th Naval District headquarters in San Francisco for a projected $1,100,000 berthing basin in Mare Island Channel on the Napa River. Approximately 215 inactive landing craft will be stored at the new basin.

Approval from Washington naval authorities has been received for the purchase of 396 acres of waterfront property north of the Sears Point bridge, where an 80-acre basin will be dredged to a 12-foot depth. Other construction includes building of two parallel levees along the shore, installation of dolphins, and electrical line-stringing.

Capt. C. R. Johnson, of the U. S. naval shipyard, Mare Island, will be in charge.

Francis T. Crowe dies; builder of great dams

Was general superintendent for contractors on Boulder and Shasta

Francis Trenholme Crowe, 63, who was called "Dam builder extraordinary," died at Redding, Calif., Feb. 26. The Canadian-born engineer was graduated from the University of Maine in 1905, with the degree of B. S. in civil engineering and 30 years later was awarded the honorary degree of Doctor of Engineering by that institution. Upon graduation, he undertook various engineering jobs and shortly became associated with the U. S. Bureau of Reclamation.

In the pre-World War I years he worked on several noted dams, including Jackson Lake, Arrowrock and McDonald Lake. As first assistant to the

Francis T. Crowe

superintendent of construction on Arrowrock, which was for 20 years the world's highest dam, he designed a comprehensive concrete conveying and distributing system, as well as a then unique pipe system for the pneumatic transportation of cement. Before terminating his connection with the Bureau, he became general superintendent of construction, office of the chief engineer.

As field representative for various contracting firms, he directed the construction of such dams as Guernsey, Deadwood River, Boulder, Copper Basin, Gene Wash, Parker and Shasta. In building Boulder Dam, as general superintendent for Six Companies, Inc., he made a remarkable record, completing the world's highest (726 ft.) dam in five years—two years and two months ahead of schedule.

Since 1939 he has been general superintendent for Pacific Constructors, Inc., on the 602-ft. high Shasta Dam, after bidding the job for another combination of contractors.

Ohio county revives Summit Reservoir plans

Long-dormant plans for construction of Summit Reservoir near Marion, Ohio, for control of the Scioto and Sandusky watershed, have been revived by the Franklin County Planning Commission as a flood control measure and to give the city of Columbus an adequate water supply.

The reservoir proposal, originally suggested in 1935, called for construction of 11 dams but this was disapproved by the U. S. Engineers who claimed that the flood control value did not justify the estimated cost. The new plans include construction of a Sandusky River dam 80 ft. high and another in Scioto River above Prospect. The reservoir would cover an area of about 30,000 acres and control drainage of 1,100 sq. mi.

Sacramento—The California Department of Public Works has sent the state's recommendations for four proposed flood control projects in the San Joaquin Valley to the headquarters, Corps of Engineers, at Washington, D. C.

The list included the 1,000,000 acre-ft. capacity Pine Flat Reservoir on Kings River, to cost $3,000,000; and the 550,000 acre-ft. capacity Isabella Reservoir on Kern River, to cost $2,000,000. Both projects have been recommended by Army Engineers and the Bureau of Reclamation.

Other recommendations were. Construction of Terminus Reservoir on Kaweah River, and construction of Success Reservoir on Tule River.

Wm. A. Van Duzer dies; former A.R.B.A. president

William A. Van Duzer, 64, director of motor vehicles and traffic for the District of Columbia and former president of the American Road Builders Association, died in Washington Feb. 23.

Mr. Van Duzer had been associated with railroad and road building most of his life. At 16 years of age he left school to carry surveyor's instruments for a New York Central Railroad construction superintendent. Later he was connected with many roadbed building programs of the New York Central in Pennsylvania.

In 1912 he joined the Pennsylvania State Highway Department as maintenance engineer, and in 1912 was made assistant chief engineer. In 1930, while serving as president of the American Road Builders Association he was designated by the State Department as a representative of the United States on the permanent commission of the International Association of Road Congresses.

Housing labor available, builders told

Estimates by the U. S. Department of Labor and the American Federation of Labor, presented to a meeting of residential builders at Chicago, Feb. 25-28, indicated that labor requirements can be met for an adjusted schedule of essential construction, incorporating the government's proposed veterans' emergency housing program.

The officials addressed sessions of the National Association of Home Builders, held at the Stevens Hotel in Chicago.

William F. Patterson, director of the apprentice training service, U. S. Department of Labor, said that the department's Bureau of Labor Statistics had estimated that 601,000 skilled on-site workers will be required to start the program of 1,200,000 homes during 1946 (*ENR*, Feb. 14, vol. p. 257).

Mr. Patterson said that requirements by trades for on-site skilled labor are as follows: bricklayers and stone masons, 39,000; carpenters, 318,000; electricians, 28,000; plasterers, 29,000; plumbers, 49,000; painters, 80,000; all others 59,000.

"If all construction labor were to be diverted to housing," Mr. Patterson said, "there would be an adequate supply to build the proposed number of houses with no training or recruitment problem. As a matter of fact, there will be other construction, and a great deal of it during the next three years. How much in addition to housing will depend on two things: a steady flow of materials in excess of that needed for housing, and an adequate number of skilled workers for the housing program and other essential construction."

Estimates of labor requirements presented by Boris Shiskin, secretary, Housing Committee, AFL, corresponded closely with the figures given by Patterson. For the peak employment period of the proposed veterans' emergency housing program in September-October, 1946 and 1947, Mr. Shiskin estimated that housing construction would take a total of 975,000 on-site workers; 590,000 skilled, 50,000 semi-skilled and 315,000 unskilled.

"In December, 1945, a total of 1,200,000 workers of all grades were employed on construction. Of this number, 755,000 were working on building construction, including about 300,000 on housing. If postponement of non-essential and deferrable construction could release 50 percent of those engaged on buildings other than residential, and 25 percent of those employed on other types of construction, the December 1945 labor force could assemble a total of 637,500 workers from all sources for housing," Mr. Shiskin said. This would leave 562,500 workers to carry on essential construction in other classifications.

In addition, Shiskin said he expects the construction labor force to be augmented by 250,000 workers filtering back to the construction ranks from discharged veterans and from shipyards.

Housing price ceiling flexible, Wyatt says

There will be sufficient flexibility in application of the proposed $6,000 price ceiling on new houses to permit work in high-cost areas; premium payments will be made only to producers of materials and not manufacturers of prefabricated components of houses, and an equitable distribution of materials will be made between prefabricators and conventional builders, Wilson Wyatt, housing chief told the National Association of Home Builders.

Mr. Wyatt said that materials will "almost certainly" be allocated for completion of houses already started in the price range "not too far" above $10,000, but that it is "doubtful" if materials could be allotted for housing in the $25,000 class.

He defended premium payments as preferable to price increases on the ground that cost would be less, since premium payment applies only to items produced in excess of base production; and thus would mean no increase in selling price to the home builder.

After hearing Mr. Wyatt defend his program, the Association adopted a statement of policy in which the group approved the goal set by Mr. Wyatt, and most elements of his program.

However, the association opposed the diversion of building materials to prefabricators, unless they could demonstrate their ability to convert such material into homes immediately, and opposed guaranteeing markets to prefabricators—as proposed by Mr. Wyatt.

The association expressed disapproval of subsidies in principle, but in response to Mr. Wyatt's insistence that they are necessary to increase production of certain basic building materials, accepted them as necessary in the present emergency.

The association also favored the use of priorities and the expansion of factory fabrication; and a modification of building codes to permit economies compatible with sound construction. It went on record as strongly opposed to the Wagner-Ellender-Taft bill.

Bonneville power revenues hit new peak

Revenues of the Bonneville Power Administration reached a new peak of $22,990,000 during the fiscal year 1945, with energy deliveries of 8,513,125,169-kw.-hr. for the period.

In his annual report to the Secretary of the Interior, Paul J. Raver, administrator, characterized the Bonneville-Grand Coulee power system as the third largest power system in the United States.

Power from the two Columbia River dams went to market over the Bonneville Power Administration transmission network, which on June 30, 1945, consisted of 2,736.8 circuit miles of lines and 55 substations.

Discussing the effect of factory reconversion on the system, Mr. Raver said that there is now a current temporary surplus of power to be remarketed in the amount of about 500,000 kw. "Studies of normal load growth for the region indicate that the power surplus is temporary, and the Administration has requested installation of three additional units at Grand Coulee to be completed during the fall of 1947 or early in 1948."

"Despite surplus of power at the dams, substantial shortages exist in the outlying areas requiring an immediate expansion of transmission facilities.

"It appears that operating results will be in the black during the reconversion period, with the help of $7,500,000 net surplus as of June 30, 1945, and the estimated surplus of $5,800,000 for fiscal year 1946."

Mr. Raver's report said that his administration had recommended a region-wide power development program based upon new multiple-purpose dam projects recently authorized or pending authorization by Congress. These would include the Hungry Horse dam in western Montana; Cabinet Gorge project, near Lake Pend Oreille in northern Idaho; the Foster Creek project; and several projects on the lower Snake River in Idaho; McNary Dam, and other projects in the Willamette River valley.

Urge increase in Canada building apprentices

Calling for an increase in apprenticeship training that would swell the ranks of skilled construction workers by 5,000 a year for the next four years, members of the Canadian national joint conference of employers and employees in the construction industry, closed a 4-day meeting at Ottawa Feb. 20.

The group, headed by H. P. Frid, Hamilton, Ont., contractor, for the employers; and Percy Bengough, president of the Trades and Labor Congress of Canada, for labor, also approved ten recommendations for publication to aid rapid advancement of the construction industry in the dominion.

The conference urged that apprentices be drawn as far as possible from the provincial technical schools or the Canadian vocational training schools for ex-service personnel.

The group also recommended that rates of pay for apprentices should be related to those of journeymen—30 percent for the first year of training, 40 percent the second year, 50 percent the third year and 70 percent for the fourth and final year.

Other recommendations included: Adoption of a standard form of agreement, adjusted to meet local conditions; disapproval of a 40-hour week; the adoption of holidays with pay; approval of hourly basis of pay, but favoring study of annual employment.

City and county at odds over San Diego's water

The recent request to the Department of the Interior for extension of a contract for Colorado River water at San Diego, Calif. (*ENR*, Oct. 25, 1945 vol. p. 547) has resulted in disagreement between the city and the San Diego County Water Authority concerning the authority's position in the future contract.

Under the present agreement, San Diego received waters of the Colorado River for ten years after completion of Boulder Dam. With the expiration of this period on March 1, wording in the contract which grants water rights to the "city and/or county" should now be altered, the water authority board thinks, to strengthen its own position with the federal government. However, city legal advisers have ruled against the municipal transfer of rights to the authority without a popular vote.

Although joint application for an extension of the contract was made finally by both groups, other ramifications of the agreement may later involve changes on matters pertaining to a city and San Diego County Water Authority merger with the Metropolitan Water District of Los Angeles. What the position of the county water authority would be in handling negotiations necessary for use of Los Angeles facilities in carrying water to San Jacinto portal is a topic of serious consideration on the board's agenda at the present time.

Virginia-D. C. boundary controversy settled

A century-old boundary controversy came to an official end Feb. 19 when Governor William M. Tuck of Virginia signed a bill writing into law a clear-cut Virginia-District of Columbia boundary line.

The new line, already approved by Congress (*ENR* Nov. 22, 1945, vol. p. 694), places the Washington National Airport in Virginia, with the status of a Federal reservation, and gives Virginia the right to regulate the sale of alcoholic beverages at the airport, and to tax motor vehicle gasoline sold there.

Kaiser gypsum plant moves to Long Beach

Henry J. Kaiser pulled his piledrivers off the job recently in Richmond, Calif., when requested by the city manager to find a new location for his proposed gypsum-products plant. (*ENR* Feb. 7, 1946, p. 206) The request was the result of action taken by the city council to prevent plant dust from becoming detrimental to nearby residential and industrial property.

Other plant sites were suggested to Kaiser by Richmond officials, but the industrialist, after being asked to move, chose to construct the new wallboard plant in Long Beach, Calif., instead of in the town made famous by his shipyards. According to a Kaiser spokesman, another plant, producing gypsum-made materials, may be built in Richmond at a later date.

The Standard Gypsum Co., partner of Kaiser in the deal, already owns calcimining facilities in Long Beach, and the new buildings will be erected on this property, using the plans intended for construction on the Richmond site.

The Long Beach location has the advantages of offering the docking facilities needed by Kaiser.

Additional sewage works ordered in Pennsylvania

The Pennsylvania State Sanitary Water Board has ordered 58 more municipalities and institutions to prepare plans for sewage treatment works. This brings to a total of 420 such notices in the state's stream clean-up program.

The board also announced that 121 industries have been notified to submit, by July 30, plans for state approval covering primary or complete treatment of industrial wastes before it is emptied into streams in the state.

Bridge Canyon project favored by Arizona

The Bridge Canyon gravity-flow route for bringing Colorado River water to the central part of Arizona will be favored before Congress by representatives of that state, according to an announcement made recently in Phoenix.

Three possible routes for the delivery of this irrigation water have been under consideration for some time, the Marble Canyon gravity route, involving 139 miles of tunnel, the Bridge Canyon gravity route, requiring a shorter tunnel and many miles of canal, and the Parker route, a combined pumping and canal project (*ENR* May 24, 1945, vol. p. 142). In October of last year the U. S. Bureau of Reclamation submitted a tentative report on these projects that found no economic justification for the Marble Canyon route (*ENR* Nov. 8, 1945, vol. p. 633). Since then the other routes have been under study.

The route now favored by the Arizona delegation in Congress calls for a dam somewhat higher than Boulder Dam in Bridge Canyon of the Colorado River, near the upper end of the reservoir behind Boulder Dam. From the reservoir thus formed, water will be carried through a 78½-mile tunnel to a point farther downstream from which water can flow by gravity to points of distribution in the Gila River basin. Cost of this project is estimated at $325,000,000.

Power can be developed at Bridge Canyon Dam and at drops on the canal system. Just how much water is to be delivered by the route is yet to be determined. Arizona's share of the Colorado River water, under existing agreements, is 2,800,000 acre-ft.

Legislation authorizing the work now is being prepared for presentation to the current session of Congress.

Start clearing ground for Allatoona Dam

Work started Feb. 18 on clearing ground for construction of the $17,400,000 Allatoona Dam and reservoir near Cartersville, Ga. The project will require three to five years to complete, and will regulate floods on the Etowah River, provide 66,000 kw. of electric power and create a 20,000 acre lake.

Located 48 miles upstream from Rome, Ga., the dam will be a concrete structure 184 ft. high, 400 ft. wide at the base, and 1,020 ft. long.

Preliminary work now under way is directed by John S. Webster, resident engineer for the U. S. Engineer District.

Offer power plan on N. Y. C. aqueducts

A plan for development of the power potential of New York City's water supply system that would relieve the city of damage suits filed in connection with the system, was proposed to the New York State legislature by the city's delegation Feb. 20.

The measure would authorize the Board of Water Supply—subject to the approval of the Board of Estimate—to lease the use of water in the city's reservoirs and aqueducts to private utilities for generation of hydroelectric power.

To qualify for these leases, utilities would be required to prove that their own facilities had been impaired by some project instituted to augment the city's water supply, and would be required to waive any claim made on this basis for damages against the city. A further condition would require the utility to supply the city with necessary power for use in the watershed itself.

The proposal, advanced by the city administration, is without precedent, since the city now has the right only to develop this power potential for its own use. Proponents of the measure said the plan springs directly from problems encountered in connection with construction of the Delaware water supply system, on which there are now pending claims totaling $5,500,000 for damages against the city brought by private utilities in the Delaware supply area.

In a memorandum to Mayor William O'Dwyer, Irving V. A. Huie, chairman of the Board of Water Supply, pointed out that power can be created under "ideal engineering conditions" in the subsurface tunnels connecting the Neversink, East Branch and Rondout reservoirs, because of the differences in elevation among the three reservoirs.

Mr. Huie said that this situation made possible development of electric current as an incident to the ordinary operation of the facilities, but said that more current would be available than needed in conection with normal operating needs. Lack of transmission lines and high cost of supplying them would make "unattractive" the proposition of bringing this power to the city itself for utilization by city departments.

Contracts with the utilities would guarantee appropriate protection of the water system, that the water would take priority over power, and that no diversion of water would be permitted for development of power.

Several states ease truck weight rules

The Kentucky legislature has passed a bill authorizing the commissioner of highways to increase the permitted gross weight of motor vehicles from 18,000 lbs. to 42,000 lbs., on designated highways.

The measure also permits lengths of single units of 35 ft., combinations of 45 ft. and height of 12 ft., 6 in.

In Massachusetts a bill, H. 914, would increase gross weight on 2-axle vehicles from 30,000 lbs. to 36,000 lbs. and the gross weight of tractor-semi-trailer or vehicles with three axles from 40,000 lbs. to 50,000 lbs. H. 915 provides the table of gross weight ranging from 28,652 lbs. if distance between axles is 4 ft. to 73,278 lbs. if axle spacing is 57 ft. Tandem axle would be permitted 32,000 lbs.

In Mississippi, a bill now in the legislature provides a table of wheel and axle weights based on tire sizes with a maximum axle weight of 18,000 lbs. It also provides a table of gross weight graduated from 26,000 lbs. if distance between axles is 8 ft. to 45,000 lbs. if distance between axles is 24 ft. or more.

The Virginia House has passed a measure to increase gross weight of four axle combinations to 50,000 lbs.

Extensive improvements proposed for Cleveland

The Public Works Panel of the Metropolitan Cleveland Development Council Feb. 20 recommended to the mayor and city council of Cleveland, Ohio, that a bond issue of $17,631,000 be submitted to the voters for approval, to finance capital improvements and to pay for maintenance by-passed during the war years.

Expenditures recommended by the panel include: $1,150,000 for city hospital and rehabilitation of the hospital's power plant; $200,000 for a city health center; $100,000 for the city's welfare institutions' improvements; $1,500,000 for the city's share for improvements at the municipal airport; $2,000,000 for a lake front airport; $100,000 for cemetery maintenance and rehabilitation; $150,000 for street trees; $1,375,000 for parks and boulevards; $1,606,000 for recreation centers; $2,350,000 for bridges; $500,000 for street openings; $350,000 for paving and resurfacing; $350,000 for a motor maintenance building; $1,650,000 for sewers; $3,000,000 for extension and rehabilitation of sewage disposal system; and $100,000 for harbor development on Cuyahoga River.

The program was designed to be carried out over a 3-year period.

Atlanta, Ga., store plans $5 million building

The management of Rich's Inc., Atlanta, Ga., department store, last week announced that it will start soon on construction of a new 8-story building, an extension of its present building vertically to the same height, at a cost in excess of $5,000,000.

The new structure, to be known as the Bridge Building, will be connected with the main structure by four bridges, beginning at the second floor. In addition, there will be two levels of tunnels between the two buildings for the movement of merchandise.

The building will be 200x200 ft., and, with the additions to the existing structure, will provide a total of 500,000 sq. ft. of additional floor space. The structure will be completely air-conditioned.

Kentucky may use road funds for airports

The Kentucky House of Representatives on Feb. 13 approved the use of $500,000 annually from state highway funds for airport work.

The bill, still to be approved by the Senate, would make airports approved by the Kentucky Aeronautics Commission a part of the highway system. The commission would use the half million a year for construction and reconstruction of the fields included in the state airport plan.

Representative Frank H. Bassett, Jr., who introduced the measure, said the Aeronautics Commission would pay out $1 for each $3 put up by local communities for airports, with the federal government matching the funds with $4.

Urge huge expenditures on street lighting

Estimating that more than 4,000,000 new light fixtures will be needed on 50,000 miles of road and 250,000 miles of residential streets in order to make lighting adequate for predicted flow of traffic, the National Electrical Manufacturers Association last week launched a program to stimulate expenditure of about $500,000,000.

The program, according to Kenneth Anderson of New York, secretary of the organization, will be aimed at state, county and municipal governments, urging the necessity of replacement and installation of new lighting fixtures in the interests of traffic safety.

Latin American sanitation conferences being planned

Sanitary engineers and technicians in Latin American countries will have an oportunity to exchange ideas with U. S. engineers if present plans for two conferences materialize. Sponsorship for the conferences, which are tentatively scheduled for Rio de Janeiro, Brazil, early in June and at Caracas, Venezuela, in September, will be provided by the Pan-American Sanitary Bureau and the Institute of Inter-American Affairs.

Abel Wolman, professor of sanitary engineering at The Johns Hopkins University, is directing plans for the meetings, assisted by Clarence Sterling, chief engineer of the health and sanitation division of the Institute.

No details have yet been made public but it is understood that the conferences will emphasize exchange of information on both design and operating techniques of water supply and sewage disposal works. It is expected that the United States delegation will include consultants, university professors and representatives from state and federal public health agencies. Quite possibly engineer-representatives of manufacturers will be invited to participate to provide information relating to the use of specialized equipment.

San Diego fails to choose county surveyor

San Diego County, Calif., commissioners last week expressed dismay at the failure of the County Civil Service Commission to fill the $425 per month post of county surveyor, although 23 applicants had taken examinations.

None of the applicants was able to pass both the oral and written tests for the job, the civil service office said. New examinations will be held in July, and in the interim John H. Vogt, acting chief surveyor has been reappointed.

The commission said that in the written examination, 12 of the 23 passed on highway and bridge design; 11 passed the test on the economics of administration, and only 7 passed the test on highway construction and maintenance.

All who passed the written examinations failed in the oral exam; failing to satisfy the examining board that they possessed qualifications for the job. The position requires that the surveyor direct the work of the road department and county surveyor's office, supervise maintenance and construction of new roads and bridges, approve plans for new roads, direct acceptance of new surveys, and be able to obtain financial assistance from the state and federal governments for new projects.

JOBS OF THE WEEK

APARTMENT, San Pedro, Calif.

J. E. Haddock, Ltd., San Pedro, will contruct by own forces apartments to cost $3,000,000. James R. Friend, San Pedro, is architect.

KANAPOLIS DAM, Kansas

U. S. Engineers, Kansas City, Mo., received lowest bid for constructing Kanapolis Dam, Smoky Hill River, Ellsworth County from Western Contracting Corp., Sioux City, Ia., $4,219,508.

ROADS, Pennsylvania

State Department of Highways, Harrisburg, received lowest bids for improving road in Mifflin County from F. D. Kessler, Inc., Northumberland, $668,068; for road in Monroe County from C. W. Good, Inc., Lancaster, $1,609,552; road in Monroe County from G. J. Packey Co., Mount Vernon, N. Y., $605,978; and road in Fayette and Somerset Counties from Cayuga Construction Corp., New York, N. Y., $686,696.

SOUND STAGES, West Los Angeles, Calif.

Twentieth Century-Fox Film Corp., Los Angeles, will build sound stages, powerhouse, storage, production office, electrical building, scene docks, etc., by own forces. Estimated cost is $5,200,000. J. S. Ferguson, West Los Angeles is engineer.

MERRIMAN DAM, New York, N. Y.

Board of Water Supply, New York, N. Y. received the lowest bid for constructing the Merriman Dam, from S. A. Healy Co., White Plains, at $14,300,800. (A low bid of $13,919,950 was received from same firm Sept. 10, 1945, and rejected as being too high.)

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 205.

OBITUARY

Robert Hoffman, 71, Cleveland, Ohio, city engineer, who during the half century of the city's greatest growth had a leading role in directing its building, died March 2. For the last fifty-two years Mr. Hoffman had the deciding hand in the building of streets, bridges, harbor improvements, public buildings and city sewage, water and light plants. He was graduated from the Case School of Applied Science in 1893.

James Lewis Morris, 83, first graduate in engineering of the old School of Practical Science, Toronto, Ont., now the Faculty of Applied Science and Engineering of the University of Toronto, died Feb. 21. He served for five years on early engineering work with the Canadian Pacific Railway; thereafter he practiced for 43 years as an engineer and surveyor in Pembroke, Ont. He served as inspector of surveys and engineer in the Department of Lands and Forests of Ontario, retiring at the age of 80.

William A. Parr, 78, formerly city engineer of Baltimore, Md., died Feb. 23.

William M. Egan, 62, employed in the Cuyahoga County Engineer's Office at Cleveland, Ohio, died Feb. 21. Mr. Egan held the position of superintendent of maintenance in the sanitary division for the last twelve years.

Christopher Steadman, 72, civil engineer, who till 1934 had been manager of the American Brick Co. for many years, died Feb. 24 at Prince's Bay, N. Y. While with the Massachusetts Broken Stone Co. of Boston, he was a pioneer in the construction of concrete highways and completed the first important concrete work on bridges and abutments for Massachusetts and New Hampshire. In 1918 he served in France with the Corps of Engineers.

William P. Morse, 82, formerly city engineer, Newton, Mass., died Feb. 21 at East Bridgewater, Mass. He was connected with the engineering department of Newton for 54 years until his retirement in 1935.

Leonard H. Davis, 73, consulting engineer of the Union Carbide and Carbon Corp., New York, died in that city Feb. 21. Mr. Davis was a graduate of Harvard, class of 1892, and a civil engineer for the Boston Transit Commission during the construction of the Boston subway. He was later employed by the Boston Elevated Railway before becoming a consultant engineer.

Capt. Victor Constant, an engineer instructor at West Point, was killed in a skiing accident near Franconia, N. H., on Feb. 24.

William F. Wall, 83, civil engineer who had been in charge of the construction of Caroin's Dam, Roanoke, Va., died in Blacksburg, Va., Feb. 18.

Joseph W. Bennett, 66, former Fresno County engineer, died in Oakland, Calif., Feb. 10. For thirty years an engineer for Union Oil Co. in San Francisco, Mr. Bennett was a graduate of Manhattan College, New York City.

Frank K. Duncan, who had served in engineering posts in Baltimore, Md., for 42 years, part of the time as chief engineer, died Feb. 20.

Archibald A. Schenck, 95, civil engineer and the oldest alumnus of Princeton University, died Feb. 20 at Newfields, N. J. He served the Union Pacific and New York Central Railroads as a civil engineer and surveyor.

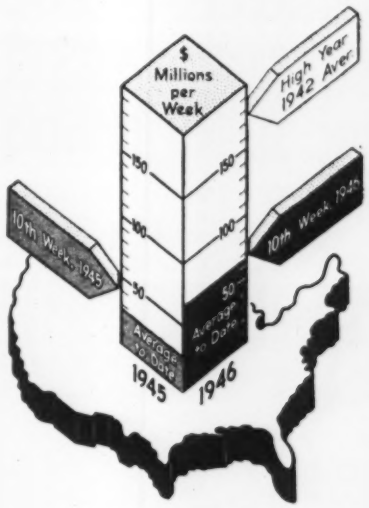
Robert C. Hill, 88, former chief of the Philadelphia, Pa., bureau of building inspection, died Feb. 13. For 50 years he was secretary of the Bricklayers Company of the County and City of Philadelphia, the second oldest trade organization in the country.

Frederick V. Hetzel, 76, Philadelphia, Pa., consulting engineer, inventor and author, died Feb. 22. Mr. Hetzel had been associated with the Link-Belt Co. for many years and at one time was the firm's chief engineer. He was a graduate of the University of Pennsylvania. His son Theodore B. Hetzel is assistant professor of engineering at Haverford.

Col. Richard Law Hubbell, 56, U.S.A. (retired), Philadelphia, Pa., engineer, died Feb. 7 in Bradenton, Fla. He was a graduate of the University of Pennsylvania and of the Massachusetts Institute of Technology. He entered Army service at the beginning of World War 1 from Watertown Arsenal, where he was employed as an engineer. He served between wars at various Army posts. He recruited his own ordinance regiment in Washington, D. C., at the beginning of the last war.

Wilbur S. Mills, 56, chief of the survey division of the General Land Office, Department of Interior, died Feb. 24 at Washington, D. C. He served the department 39 years.

CONSTRUCTION ACTIVITY



As Reported this week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Mar. 7 1946	Cumulative 1946 (10 wks.)	Cumulative 1945 (10 wks.)
Federal	$5,805	$72,451	$155,270
State & Mun.	15,491	139,054	29,832
Total Public	21,296	211,505	185,102
Total Private	47,073	453,166	93,482
U. S. Total	**$68,369**	**$664,671**	**$278,584**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1946 (10 wk.)	Cumulative 1945 (10 wk.)
Waterworks	$1,142	$10,744	$7,433
Sewerage	1,618	7,278	6,788
Bridges	820	17,099	6,918
Highways	9,391	74,299	13,095
Earthwork, Waterways	2,448	39,457	6,508
Buildings, Public	3,365	48,281	107,955
Industrial	14,942	195,519	66,962
Commercial	29,634	225,014	17,612
Unclassified	5,009	47,080	45,313

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (10 wk.)	Cumulative 1945 (10 wk.)
NON-FEDERAL	$156,869	$122,280
Corporate Securites	67,004	9,595
State and Municipal	89,865	112,685
FEDERAL	158,320	77,137
Total Capital	$315,189	$199,417

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Mar. '46	323.83	155.66
Building Cost	Mar. '46	245.41	132.66
Volume	Feb. '46	167	73

EDITORIALS

VOLUME 136 NUMBER 10

March 7, 1946

Paternalism Unpopular

NEITHER the construction industry which will have to build the houses nor the veterans who will be asked to rent or buy and live in them are showing any great enthusiasm for the government's projected housing program. The reason does not need deciphering for it is plain that the paternalism involved is definitely unpopular. Few of the manufacturers of building materials and of prefabs want the subsidies that are planned for them, and a growing number of the veterans are seeing in the 90 percent mortgages on inflated values, which are proposed, an unusually poor investment not only for themselves as individuals but as members of the taxpaying community. As was stated in these pages right after the program was announced, its basic fault lies in its use of artificial incentives at a time when none is needed. If ceiling prices are liberalized to a point where profit opportunities are attractive, the materials and even the prefabs will become available in great and growing quantities. And as soon as the materials markets are functioning, prices will stabilize, inflation will be checked and veterans will be provided with housing opportunities that they can grasp with confidence. Congress will do better to concentrate on means of releasing the power of free enterprise by restoring the freedom to make a profit than by looking for artificial devices to force production and induce investment.

Philadelphia Comes Back

FOR THE PAST DECADE or more Philadelphia has had few rivals for the title of most run-down American metropolis. Poor management, bad politics and municipal apathy to reform led her as near to bankruptcy as a city can get. Sometimes referred to by her less delicate critics as "corrupt and contented", Philadelphia is showing definite signs of resenting the slur. Last week, for example, the city council approved a $78,200,000 program of public improvements as preliminary to submitting the proposals to the voters in May. Largest single item is $34,000,000 for new sewage disposal facilities, and included also are $10,000,000 for airports as well as other millions for modernization of the city hall, for hospitals, subway extensions, flood control and port improvements. A great new water-supply program is yet to be acted upon. Not since the Delaware River bridge and the Market Street subway were built have the noises of construction rung out where once the Liberty Bell pealed. It will be a welcome disturbance, accompanied as it is by the tinkle of cash in the city treasury. Only recently approaching a state of mendicancy, Philadelphia today has a cash and credit position exceeded only by ten other major municipalities, and in no case is the comparison extreme. Philadelphia has come a long way. It is now up to the citizens in the May election to complete the renascence and return their city to the place it deserves among American municipalities.

Savings on River Transportation

FIGURES GIVEN IN OUR ISSUE of February 21 on the cost and quantity of water-borne transportation on the Tennessee River emphasize the need for a changed viewpoint with respect to waterway charges. The figures indicate an expected saving of $2 per ton for all commodities, exclusive of short-haul sand and gravel, but this saving to shippers is offset by a cost of about $1.50 per ton (again exclusive of sand and gravel) paid by the public for construction and maintenance of the waterway. The shippers who benefit by these savings on the Tennessee and other waterways pay no greater share of the operating and maintenance costs than does any other taxpayer, including their competitors in some instances. This is unsound as a continuing national policy. True, many railroads were subsidized in their early days, and more recently highway users received federal aid. But these were temporary expedients. Now that inland waterways have been developed to the point where shippers find it quite profitable to use them, the shippers should pay their own way.

Underwater Tunnel Construction

A NOTABLE ADVANCE in the technique of underwater tunnel construction was made at Rotterdam during the war, as reported elsewhere in this issue. Precasting the river sections of a vehicle tunnel and sinking them to final position is not new, but the sections of the Rotterdam tunnel are the largest yet built and the methods used in floating and sinking them are distinctly novel. Also noteworthy are the caisson used to make the final closure between the underriver sections and the device used to pack a firm sand

bed under the sections after they were in place. The first vehicle tunnel to be built by sinking precast sections was under the Oakland Estuary in California. There followed the Detroit and Mobile tunnels. In each of these, however, only one tube containing a single two-lane roadway was used. At Rotterdam, two two-lane passageways for vehicles and smaller passageways for pedestrians and bicycles were cast into a single rectangular block, thus greatly increasing the mass to be maneuvered into place and complicating the task of getting the section set to proper line and grade. And as was to be expected, the system for doing this that was devised by the contractors shows many refinements over those used on the earlier operations. The accuracy of setting that was obtained fully justified the brainwork and money that went into the design and construction of the special equipment.

Correlative Highway Research

LONG AWAITED and urgently needed, the newly inaugurated correlation of the research work sponsored by the Highway Research Board of the National Research Council with that of the Public Roads Administration and the American Association of State Highway Officials augurs much for the advancement of highway construction.

As announced at the recent Highway Research Board's annual meeting in Oklahoma City, this correlation of research will be implemented by four definite steps: (1) Determination of what subjects should be given first priority; (2) a detailed study of what already is known about the priority subjects; (3) formulation of a research program geared to keep pace with highway construction; and (4) division of the program into units of workable size.

That a well correlated program of highway research is urgently needed, few will deny. Such fields as the stabilization of subgrades, bituminous pavements, joints and shear-transfer devices in concrete pavement, the archaic and empirical formulas used for calculating impact due to live load on bridges, and many other subjects offer vast opportunities for the highway research engineer.

Too much emphasis cannot be placed on the necessity of a critical study of past practices in highway design and construction. Those who have guided this development now have an opportunity to record past performances and experience for future use in extending, expediting and adapting the fruits of research to the practical problems of highway development.

Toward Better Engineering Service

CONSULTING ENGINEERS, ever watchful for ways of improving their services to their clients, would do well to consider some recent remarks of M. J. Madigan, of the New York firm of Madigan-Hyland.

Speaking before the Metropolitan Section of the American Society of Civil Engineers on his experience in designing a $45,000,000 fruit and vegetable market for the City of New York, he described the tremendous job of fact-finding that was carried out before a site was selected or any layout of the physical facilities was undertaken on the drawing boards. Of a fee of about $190,000, nearly 65 percent was expended before the actual designing began.

Mr. Madigan pointed out the great savings that are inherent in designs based on a complete certainty as to facts as against those that rely too much on guesses or the consultant's judgment, no matter how well bolstered by past experience and comparisons with "similar" jobs. Just one fact among the many that were established, namely that the market would at no hour in the twenty-four contain more than 68 percent of the day's inflow of produce, permitted huge design and construction economies. Moreover, it enabled the consultant to draw up a financial plan for building and operating the market that he could recommend to his client with absolute confidence.

Such advice is worth money to the client, and by the same token it justifies generous fees for the consultant. Lawyers have long received such fees for less valuable services. Too many engineers merely grow melancholy and embittered over this situation, and decry the lack of appreciation that is shown for their contributions to our economic system and to society generally. Mr. Madigan took more positive action by demanding a fee that would cover extensive fact-finding and research, and then proceeded to justify it to his client. The Madigan formula is worth wide emulation as a sound means of raising both the standing and the value of engineering service.

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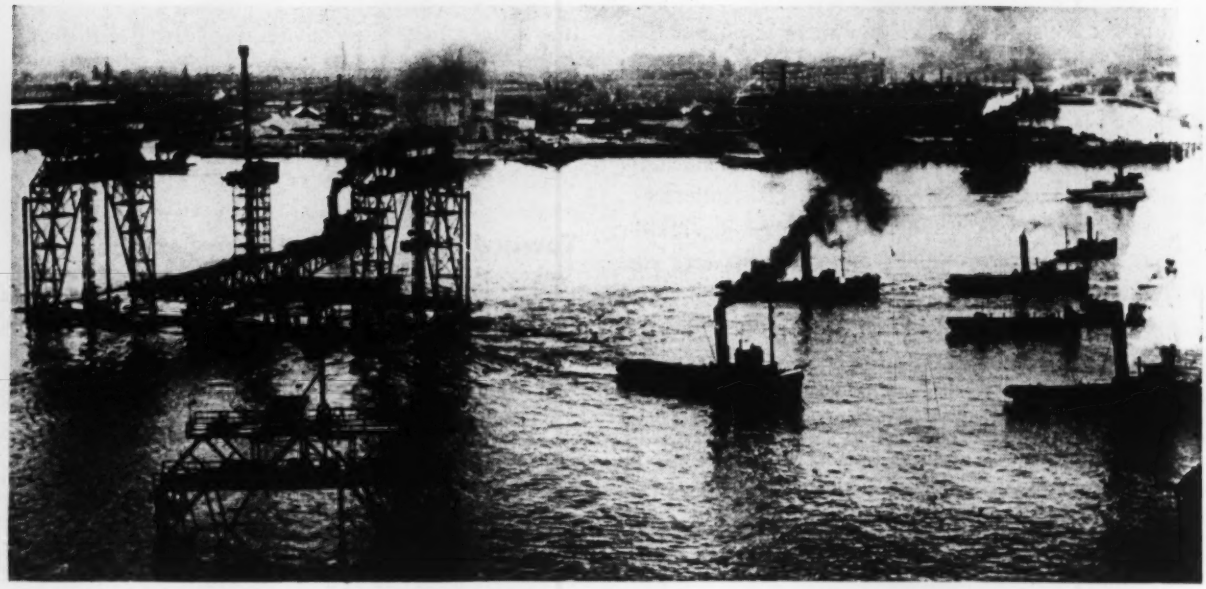

Fig. 1. A precast section of the tunnel, equipped for sinking (left center), being floated to its position in the Maas River.

Precision Control in Sinking Prefabricated Sections for Maas Tunnel

***Contents in Brief**—In Rotterdam, Holland, bombed and invaded in 1940, the Maas River tunnel was completed under German army occupation. The under-river section, 1,926 ft. long, was constructed of nine prefabricated concrete units 81x28x201 ft. that were sunk and connected under water. A unique method of supporting units clear of river bed on spuds enabled placement of foundation underfill. Underwater units were connected in compressed air by a diving bell spanning the full 81-ft. width of a unit. Control towers on units made it possible to bed them within a small fraction of an inch of true line and grade.*

CONSTRUCTION of the Maas River tunnel at Rotterdam, Holland, has the unique distinction among great tunnels of being interrupted by an invading army, escaping aerial bombing that almost destroyed a great city and resuming activities by consent of the soldiers of a foreign nation. Actual work was begun in 1938, stopped by bombing in May, 1940, resumed after invasion in 1940 and completed in 1941.

Aside from interest as a war casualty, the Maas River tunnel is the largest in cross-section to be constructed by sinking prefabricated sections to the riverbed and connecting the ends under water. Especial interest lies in the plan and the precision methods adopted in sinking the ponderous concrete sections so as to control the line and grade accurately. Distinctive details were the injection of a dense sand foundation under the sections before they were finally bedded on the river bottom and the jointing of the section ends by using a specially designed diving bell.

Details of the structure, construction plant and procedure (supplementing the description in *Engineering News-Record* Nov. 7, 1940, vol. p. 608, when work was still shut down because of the bombing of the city) are given here with particular attention to illustration. For this greater detail we are indebted to an article in the French Magazine *Travaux*, March 1942, by Lassen Nielsen, manager N/V Christiani & Nielsen, of The Hague, Holland, and to Henning O. Christiani, vice-president, Christiani & Nielsen Corp., New York, N. Y.

The traffic demand for an additional crossing of the River Maas separating the north and the south sections of Rotterdam is indicated by the designed capacity of 12,000,000 vehicles a year and 3,200 bicycles and 32,000 pedestrians an hour for the new tunnel. As is common in Europe, only general requirements were specified and large engineering-contracting firms were asked to submit designs, construction plans and cost figures. The proposal adopted was essentially that of N/V Christiani & Nielsen based on a design and a construction plan developed by Christiani & Nielsen, Copenhagen, Denmark, A. E. Bretting being in charge of the work.

The structure planned consisted of two cut-and-cover ramp tunnels 906 ft. and 696 ft. long and an under-river tunnel 1,926 ft. long between ventilating buildings as shown by Fig. 2. Only the under-river tunnel is described further. As shown by Fig. 3, the cross-section provides for three tubes, two for vehicular traffic and the third in

two stories, an upper for bicycles and a lower for pedestrians. All tubes and the accompanying ventilating and other service ducts are included in one rectangular casing of reinforced concrete. Overall dimensions of the precast units are given in Fig. 3.

The ramp tunnels and river tunnels connect in the ventilating buildings as shown by Figs. 2 and 4. These structures are founded on heavy concrete caissons sunk by the pneumatic process. Ventilation of the river tunnel is by under-floor ducts each way from the middle to the ventilation buildings, and for the ramp tunnels it is by roof ducts down the slope to the ventilation buildings. The direction of air flow in these ducts is indicated by Fig. 4. Fig. 4 also shows the street entrance for cyclists and pedestrians who enter and leave the tunnel by four escalators at each ventilation building. Only vehicles use the ramp tunnels so these sections have only two tubes.

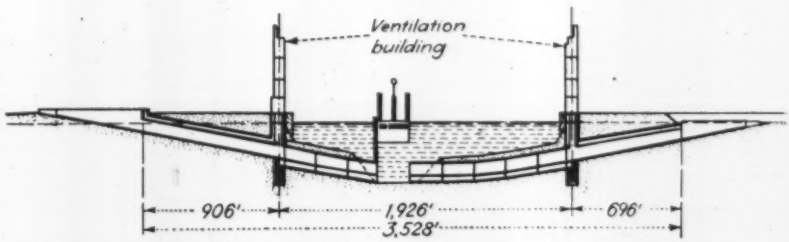

Fig. 2. Profile section of the Maas River tunnel showing the order in which the prefabricated sections forming the under-river tunnel were sunk working from each end.

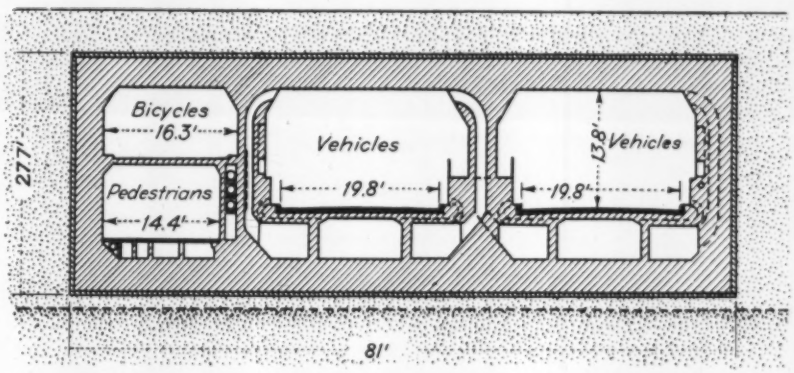

Fig. 3. Under-river cross-section of Maas River tunnel, showing traffic tubes. It is the largest tunnel ever constructed of prefabricated sections.

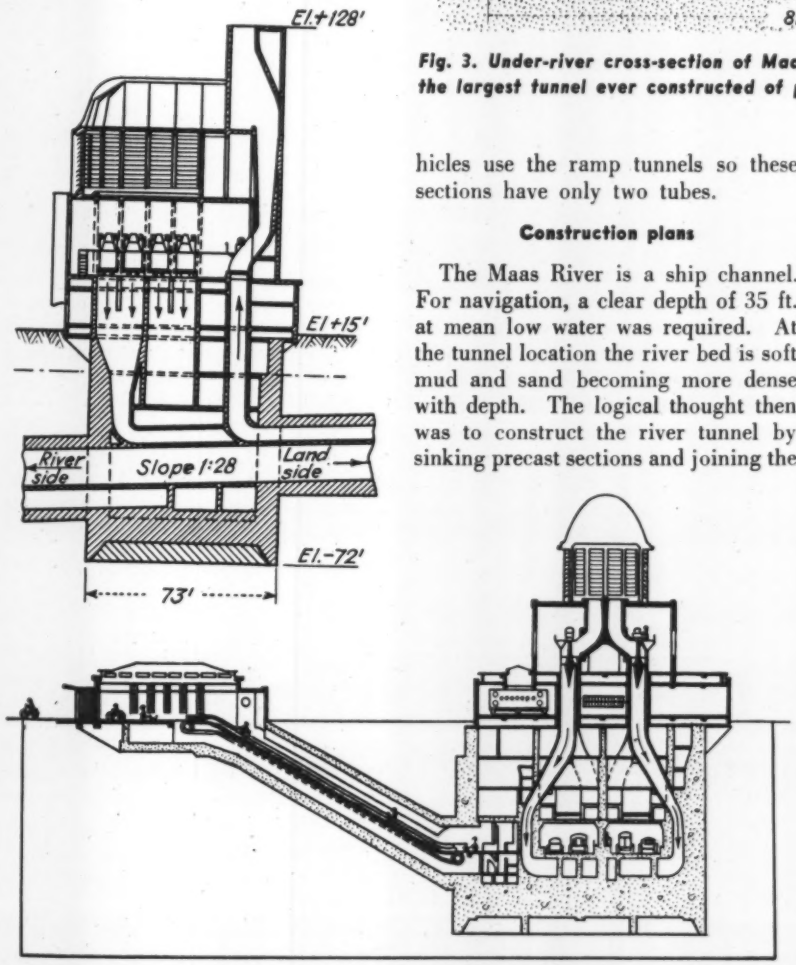

Fig. 4. Sections of one ventilating building showing the arrangement of air intake and exhaust ducts. Foot and bicycle traffic leave the tunnel by the escalator shown in the lower section.

Construction plans

The Maas River is a ship channel. For navigation, a clear depth of 35 ft. at mean low water was required. At the tunnel location the river bed is soft mud and sand becoming more dense with depth. The logical thought then was to construct the river tunnel by sinking precast sections and joining the ends under the water. This presented a foundation problem. As a minimum, the tunnel had to provide for four-lane vehicular traffic, with accommodations for cyclists and pedestrians. The need for easy gradients indicated a side by side location of the traffic tubes, and this required a structure that was wide in proportion to its height. Possibility of uneven bearing power of the river bed soils presented a hazard that had to be avoided; any tilting of the flat precast sections threatened cracking or the distortion of tunnel line and grade. Choice of the Christiani & Nielsen proposal was influenced by the foundation construction (described later) that was planned to prevent settlement.

As shown by Fig. 2, the space between ventilation buildings was divided into nine sections, uniformly 201 ft. long with 3-ft. jointing spaces between ends. This length also permitted three sections to be fabricated simultaneously in the Heysche Haven drydock a short distance upriver.

The widths of the precast sections was 81 ft.; the depth of the center section was 27 ft. 7 in., and the depths increased to 31 ft. 4 in. at the ventilation buildings. This variation in depth reduced the midchannel excavation and increased the ventilating duct capacity as needed toward the ventila-

tion buildings. Another variation was a thicker bottom for the midriver sections to resist the greater water and earth pressure at the depth of 73 ft.

Prefabrication of sections

Construction of the sections was in two stages, involving a considerable towing operation at the end of each stage. The first stage was carried out in the drydock which was large enough for work on three sections at the same time. The 16-ft. depth of water available in the dock, however, permitted construction only to a height which gave the section a draft afloat of not over 14 ft. Preparation for towing consisted of closing the end openings and erecting timber sheeting side and end walls topping at the 30-ft. level. This inclosure gave ample freeboard for towing to the construction dock, as shown by Fig. 7.

This dock had 36 ft. of water and mooring space for six sections. Here the upper half of the section was concreted behind the timber sheeting and the end openings were closed by concrete bulkheads. As completed, the weights of the section were 1,300 to 1,400 tons greater than the water displacement. To lift it for towing, five 8,000-cu.ft. steel pontoons were attached to each side below water. When pumped out these pontoons floated the section with about a foot freeboard.

With the section afloat, the temporary timbering was stripped and the top was fitted with the control bridges

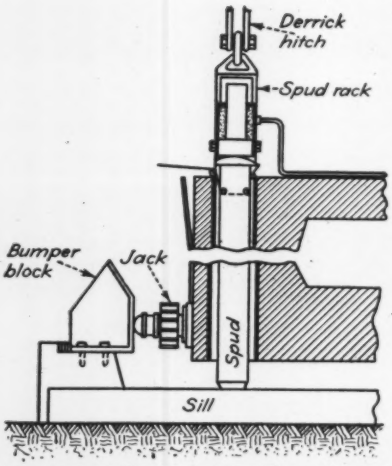

Fig. 5. Detail of spud bearing, bumper block and jacks for maneuvering tunnel section to true line and level.

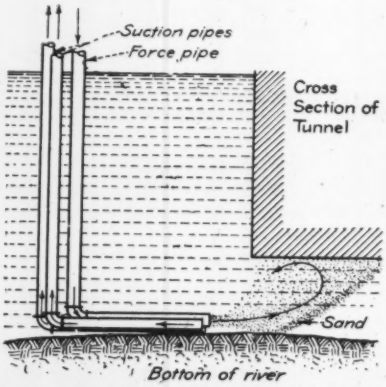

Fig. 6. Schematic diagram of injector action in placing sand underfill.

and with the traveling-gantry device for placing the permanent foundations. The picture of the model, Fig 9, shows the outfitted section. It will be noted that the underwater location avoided any effect of the pontoons on stability in sinking the caissons.

As outfitted, the section was towed to the tunnel line, and spotted over its exact location. Six anchors, two on each side and one on each end, held the section in position by cables to electric winches set on the bridges of the control towers.

Sinking of sections

An across-river trench was dredged for the tunnel emplacement. Across this trench precast concrete sills, 95 x 10 ft. x 2 ft. 7 in., two for each section, Fig. 10, were placed by floating derricks. The purpose of these sills was to hold the section, by means of spuds footing on them, some 30 in. above trench bottom so that the final foundation underfill could be placed. This arrangement is indicated by Fig. 8.

Sinking a section was largely a problem of securing accuracy. Briefly, the section was suspended from and lowered by floating derricks, but this statement alone is small indication of the devices, processes and precautions that secured accuracies of a small fraction of an inch in line and grade. Some of the mechanical devices were unique both in design and application.

Three control towers were used (Fig. 9); a so-called "fixed" tower on the free end of the last section sunk and two on the section to be sunk, a "master" tower on the end nearest the section in place and an "auxiliary" tower on the opposite end. This "auxiliary" tower, after the section was sunk, was left standing to serve as the "fixed" tower for sinking the next section. The master tower, like the bridge of a ship, was the station for controlling all sinking operations.

Each section was fitted at each end with four jack-operated sliding spuds of steel. The four spuds at the master tower were operated as one but the four at the opposite end were operated in right and left couples. Thus the section, with its spuds extended, came to rest on the sills with a three-point support for static balance. Also, whatever the elevation-profiles of the sills were, the level and grade of the section could be rectified by operating the three sets of spuds as required.

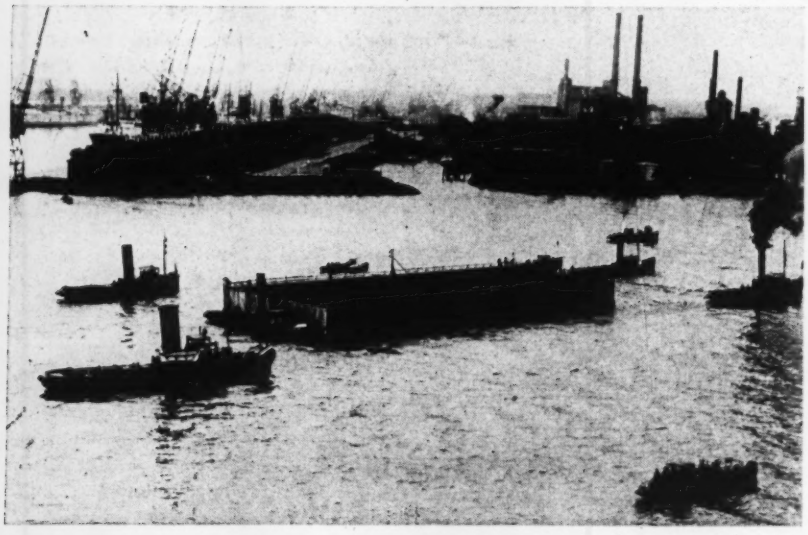

Fig. 7. Concreted half-way up in drydock, a tunnel section fitted with timber sides and ends is here shown being towed to a deep-water dock for outfitting.

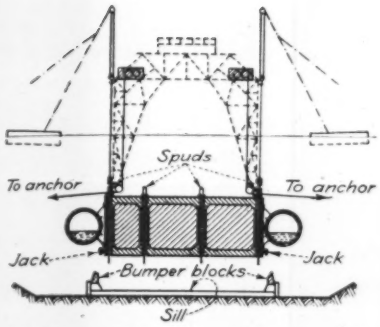

Fig. 8. Schematic diagram of operation in sinking a tunnel section to its spud footing on the concrete sills.

The sill ends, as indicated by Fig. 8 and detailed in Fig. 5, were fitted with cast-iron guide blocks between which the tunnel section was lowered. Jacks, located as shown in Fig. 5, provided power for shoving the section right or left into true alignment. These jacks, like those operating the spuds, were operated from the "master" control tower. They were sunk attached to the sections, Fig 8.

The sections were lowered by four floating derricks hooked to the corner jacks, Figs. 5 and 8. The two 80-ton derricks at the master tower acted as a couple by taking lift on an 80-ft. walking beam, but the 140-ton and the 250-ton derricks at the auxiliary tower acted separately. Thus, the section had three-point suspension. The section was maneuvered into line as checked by a specially constructed master-tower transit sighting on targets on both ventilation building simultaneously. The anchor cables were held taught and enough water was admitted to the pontoons to give the derricks a small load.

Progress in sinking

Water was admitted first to the pontoons at the auxiliary-tower end and the derrick lines at this end were slacked off enough to give the section a dip downward toward the forward end. This was to diminish the effect of waves and surge as the section submerged. Water was next admitted to the pontoons near the master tower and then to all pontoons. The pontoons were filled and the derrick lines slacked off gradually and under control from the master-tower bridge where level and transit observers followed every movement of the sinking section. The final seating of the section on the spuds on the sills was particularly cautious.

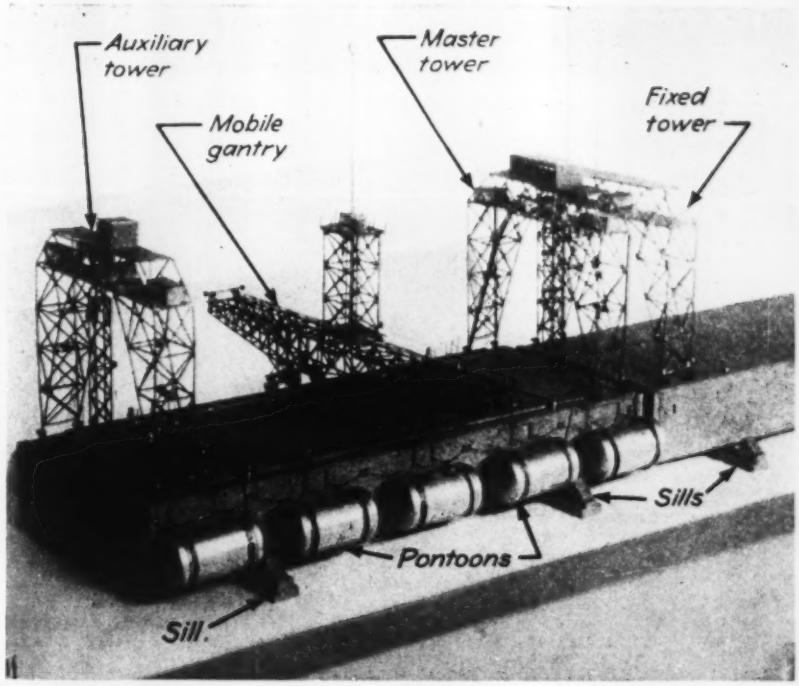

Fig. 9. Model of tunnel section outfitted with control towers, mobile gantry device for making foundation underfill, and steel pontoons.

Fig. 10. Sinking precast concrete sills across the foundation trench provided footings for spuds that supported the tunnel section for the foundation underfill.

Generally the sinking speed was about 12 in. per minute and a section was seated in about an hour. In some cases, the speed had to be reduced to 8 in. and even to 4 in. and the time of seating was doubled. When the final adjustments were made by the jacks and the pontoons and derricks had been removed, no inaccuracy of line or grade exceeded a quarter of an inch.

As previously stated, because of uncertainty of uniform bearing power of

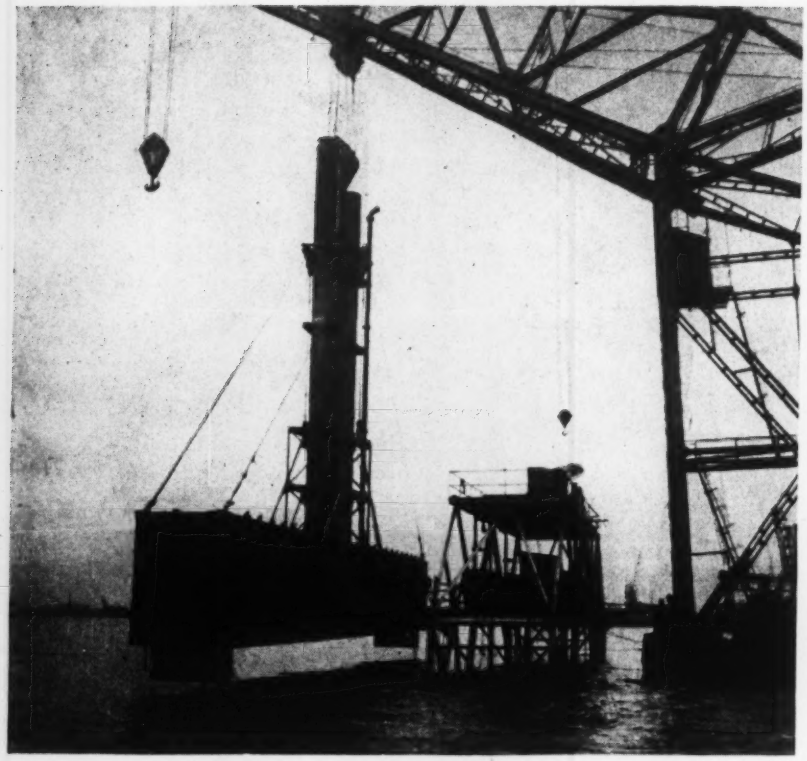

Fig. 11. Large diving bell lowered over roof gap between ends of tunnel sections enabled closure in compressed air.

the river bed soils, the construction plan included a foundation fill of uniform sand. The ingenious method of injecting this sand as an underfill after the tunnel section was sunk is shown by Fig. 6. As supported on the spuds, the bottom of the section cleared the bottom of the dredged trench about 3 ft. This space had to be filled solid with sand placed under water.

As shown by Fig. 9, each section was fitted with a gantry traveling on rails running lengthwise between towers. This gantry spanned the width of the section and cantilevered out 10 ft. beyond its sides. A tower, carrying the sand injection machinery, traveled the length of the gantry bridge. This device permitted injection from either side of the section and at any point along the sides.

Operation of the sand injection is indicated by Fig. 6. Sand suspended in water was forced through the middle 8-in. pipe and under the section where it packed in. The 7-in. side pipes (air lift) at the same time sucked out water about equal in volume to that brought in with the sand and so reduced turbulence and increased sand compaction.

As the sand filled the space under the section the pipe nozzles were retracted and the point of injection was shifted as required. The time for change was indicated by the amount of sand that was returned by the suction pipes as completed fill blocked further deposition. The velocity of the pressure stream was 13 ft. per sec.

Previous to injection, the section was allowed to rest on the spuds and sills for 24 hr. so that any considerable sill settlement would have appeared. The transfer of the weight of the section from the spuds and sills to the sand fill proceeded very slowly so that the squeezing out of water would not carry away sand. The final settlement under full load was a small fraction of an inch uniformly throughout, indicating that the injection process had created a dense fill.

Joining the sections

The sections were sunk with the end openings closed by concrete bulkheads. To close the gaps between ends of sections required building under water what amounted to a thin slice of tunnel with walls, traffic tubes and ducts. Generally the procedure was to drive semicylindrical sheets of steel to span the side-wall gaps. Inside these, flat sheets of steel were placed as chords flush with the sides of the section. The spaces between steel sheets were then filled with concrete placed under water. To close the roof gap a 55-ton diving bell, Fig. 11, was lowered to cover it, and the roof slab was concreted in compressed air. The remainder of the work was done from the inside.

When the work of lining the tunnel was undertaken it was found that remarkable perfection had been achieved in both the line and grade of the underwater sections.

Planned accuracy

This accuracy was a calculated accomplishment. To lower concrete blocks weighing 12,000 to 13,000 tons through depths of water increasing to 73 ft. required the control and balancing of powerful dynamic forces. These forces were anticipated and calculated as accurately as possible and the devices to regulate them were planned and prepared in advance. Some of these devices, controllable tension on the anchors, the control towers, the pontoons that regulated sinking weight, the floating derricks, have been indicated.

To function, these main units required auxiliary operational devices—hydrometers and manometers to indicate and control water ballast in the pontoons; air and water inlets operated from the deck; extra water valves available to divers; relief valves on the bumper block jacks to cushion lateral oscillations when seating a section; winches to regulate anchor cable tension; levels on the master tower to check the dip of the sections to correspond to the tunnel grade; transit instruments to check alignment; glass gages connected to shore tanks to check elevations; and colored light signals.

All direction of the many control devices was centered at the operating bridge of the master tower. Here, like the captain of a docking ship, the engineer in charge had under his eye and hand every maneuver of the unwieldy floating vessel that he commanded. The height of precision required is indicated by the fact that the power at his disposition for the sinking was only 3 percent of the weight of the section to be sunk.

Construction was carried out by N/V Christiani & Nielsen in conjunction with three other contracting firms, a separate company—N/V Maastunnel—being formed for this purpose.

More Effective Use of Rivets and Bolts

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***Contents in Brief**—Significant changes in the use of structural rivets and bolts may result from recent revisions of American Institute of Steel Construction design specifications and establishment by American Society for Testing Materials of requirements for rivet and bolt steel. Other developments include cold driving of rivets and use of bolts subjected to tension only in main shear connections.*

NEW STANDARDS, revised specifications and novel construction techniques for structural rivets and bolts may cause radical changes in present field and office procedures. It is significant that use of cold-driven rivets is increasing, and completely bolted multi-story buildings eventually may be commonplace.

One indication of the latter possibility is seen in a recent decision of the Board of Standards and Appeals of the City of New York. Here the use of unfinished bolts, equipped with lock nuts and washers to insure full unthreaded barrels for their entire bearing length, was approved for all field connections of beams or girders to columns for the steel frames of the thirty-five 12- and 13-story buildings in the Metropolitan Life Insurance Company's Stuyvesant Town development (*ENR* Feb. 15 and 22, 1945, vol. p. 230 and 243). All other field connections, including column splices, will be made with ordinary unfinished bolts, as permitted by the building code.

During the past few years, considerable attention has been given to the development of rivet and bolt steel for specific uses, and, much work has been done in testing the static strength of riveted joints. A comprehensive study of the resulting data recently has caused the American Institute of Steel Construction to revise its *Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings* to permit an allowable unit tension stress in rivets and bolts of 20,000 psi. The stressed area is based on the nominal diameter of rivets and on the nominal root diameter of threaded bolts. The old allowable unit tension values were 15,000 psi. for rivets and 12,000 for bolts.

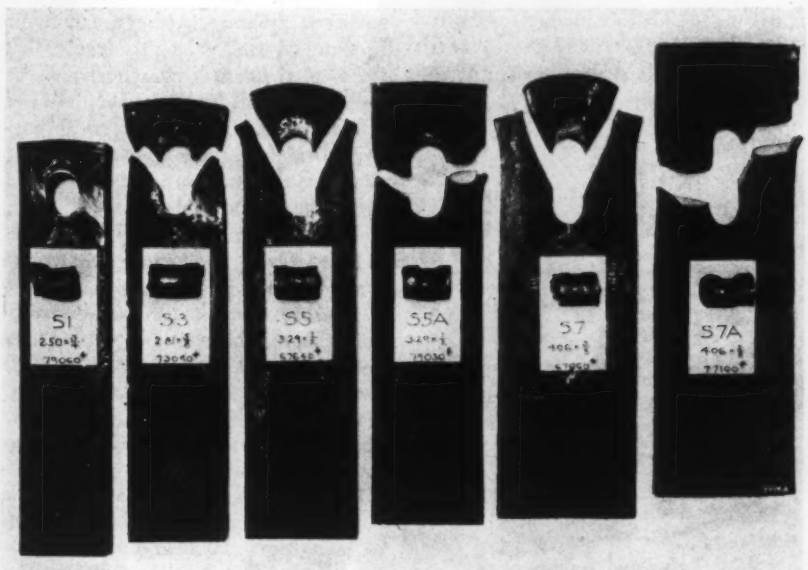


Fig. 1. Failure in riveted joints of thin material tested by Bethlehem Steel Co. was caused by rivets punching out ends of plate.

Investigations of riveted joints up to 1940 have demonstrated that regardless what the load distribution is initially, it tends to equalize at the point of failure and that most consistent and accurate stress values for shear result from joints in double shear. (Jonathon Jones, "Static Tests of Riveted Joints" and "Fatigue Provisions in Riveted Joints," *Civil Engineering*, May and June, 1940). These studies also show that a working value of 40,000 psi. is warranted for rivets with enclosed bearing. This value of 40,000 psi. was written into the AISC specifications for buildings in 1936 as a result of Bethlehem Steel Co. experiments in 1935 and extensive European tests. (F. H. Frankland, "European Developments in the Study of Impact and Fatigue in Structures," 1940 annual meeting of the American Society of Civil Engineers).

In the thinnest material tested at Bethlehem, rivet bearing values of 165,000 psi. were observed before joint yield and 204,000 psi. before failure, with a minimum ratio in these tests of breaking stress to the permissible bearing stress of 40,000 psi. of 3.85. The test specimens invariably failed by the rivets punching out the ends of the plates (Fig. 1). As a result of these investigations, the AISC specification was revised to provide for as much shear area in the plate behind the rivet as in the rivet itself.

The recently revised AISC specification also provides rules for the proportioning of plate girders, cover-plated beams and rolled beams by the moment of inertia of the gross section. No deduction is required for standard shop or field rivet holes or bolt holes

in the flanges, except that in cases where the reduction of area of either flange by such holes exceeds 15 per cent of the gross flange area, the excess is to be deducted. If such members contain other holes, as for bolts, pins or countersunk rivets, the full deduction for such holes are to be made. The deductions thus applicable to either flange are to be made also for the opposite flange if the corresponding holes are present.

Frictional resistance important

The force produced by elastic tension, resulting from the cooling of a hot-driven rivet or the elastic elongation of a bolt when the nut is tightened, clamps the faying (or facing) surfaces of a joint. This adds to the strength of a joint, accounting for as much as 15 per cent increase in resistance to shear, but it is not taken into account by conventional design methods or by specifications, as it should. Tests in this country and in Europe have shown that this clamping force remains practically constant up to the point of failure of the joint from overload. It is this added joint resistance that is responsible for the prohibition against the use of shop paint on the faying surfaces of a joint, so that frictional resistance would not be lost.

An extreme example of the utilization of clamping force in the design of main shear connections is the use of bolts subjected to tension only. The German Messerschmitt fighter plane and others incorporated such a connection as standard method for attaching wings to the fuselage. Slightly corrugated faying surfaces are provided at the joint, with the wings and fuselage connected by bolts passing through holes of substantially greater diameter than the shanks. As the elasticity of the bolts and the rigidity of the bolted assembly is all-important in the efficient functioning of a threaded connection subject to fatigue, impact and vibration, the nuts are turned up so as to cause tension in the bolt slightly exceeding the elastic limit of the bolt material.

The result of this procedure is that the initial tension is always greater than that imparted by the load. Thus, the increased bolt loading not only improves the fatigue strength of the bolt but also increases the resistance to loosening of the nut under severe vibration. Usually, a cyclic variation of the bolt load is the principal cause of nuts becoming loose. The most valuable use of lock nuts is in an application where the vibration of bolt load is large, or where the bolt load is small and vibration is severe.

Requirements for rivet steel

Perhaps, one of the most important of the recent developments that will affect the use of rivets is the newly established standards for rivet steel. In *Standard Specifications for Structural Rivet Steel,* ASTM, A 141, are covered the requirements for soft carbon steel for rivets for use with standard structural carbon steel as called for in ASTM, A 7, *Specifications for Steel for Bridges and Buildings.*

The physical requirements for this rivet material provide a tensile strength range of 52,000 to 62,000 psi. and a minimum yield point of not less than 28,000 psi., with a minimum percent elongation in 8 in. as given by the formula, 1,500,000 divided by the tensile strength. Due to the work done in driving, the rivet in place will possess a yield point equivalent to the base material.

In *Standard Specifications for High-Strength Structural Rivet Steel,* ASTM, A 195, is described a material that is, with proper driving technique, suitable for use with standard structural silicon steel (ASTM, A 94) and equivalent steels. The chemical composition of this rivet material is specified to contain, by ladle analysis, percentages of carbon of 0.30; manganese, 1.65; and silicon, 0.25. Physical requirements call for a tensile strength range of 68,000 to 82,000 psi. and a yield point of not less than 38,000 psi., with a minimum percent elongation in 8 in. as given by 1,600,000 divided by the tensile strength.

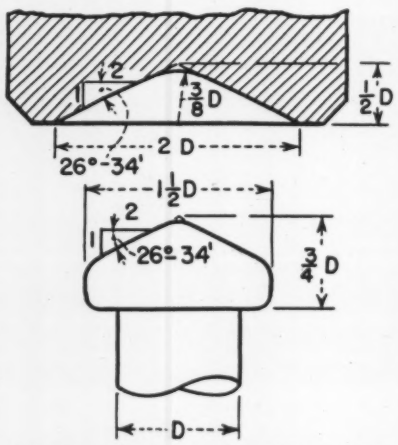


Fig. 2. Conically shaped head is more efficient for cold-driven rivets.

It is seen that this high-strength rivet is of silico-manganese material, and as such is not sufficiently resistant to corrosion for use with low-alloy structural steel (ASTM, A 242), which has four to six times as much resistance to atmospheric corrosion as have the standard carbon and silicon structural steels. An ASTM specification for rivet material suitable for use with the A 242 steel is now being developed.

Cold-driving technique

The use of cold-driven structural rivets in steel for buildings, bridges and other types of structures, such as gas and oil tanks, has been increasing in recent years both in this country and in Canada. Also, during the war, large high-strength alloy-steel rivets were driven cold in certain types of armament subjected to severe ballistic shock.

The use of standard structural grades of rivet steel such as ASTM, A 141, for cold driving, and the employment of standard manufactured heads is satisfactory, and there is, therefore, no necessity for duplicate stocks of rivet material in the shops. All cold-made rivets used for cold driving must be of annealed material. Hot-made rivets do not require annealing, although they should be quenched.

Proper technique in cold driving requires that the rivet be driven under sufficient pressure, with an automatic pressure-control valve, to insure that the rivet shank will completely fill the hole before the formation of the head is completed. Cold driving, with controlled safe pressures as determined for rivet size and material, causes the rivet to fill the hole completely.

In cold driving structural rivets from $\frac{1}{2}$ in. to $1\frac{1}{4}$ in. in diameter, control of the speed and action of the riveter by a pressure control valve is all important. There is then no perceptible temperature shrinkage of the shank, either longitudinally or diametrically, nor loosening under vibrating loads or shocks, as the rivets are in full shear or bearing. Since there is no temperature expansion to be allowed for, the clearance in holes should be held as close as practicable and need not be as great as that for hot rivets.

In cold driving $\frac{7}{8}$-in. standard structural carbon steel rivets under con-

trolled pressure, the physical characteristics have been found to be as follows:

	As rolled	Cold driven
Tensile strength, psi.	57,000	68,000
Yield point, psi.	34,000	57,000
Reduction of area, percent	71	67.1
Elongation in 8 in. (min. per cent)	42	29.3

The severe cold work in driving increases both yield point and tensile strength by slightly less than 70 percent and about 20 percent, respectively, and reduces the ductility by about 30 percent. In order to avoid over-driving, which might cause warpage, it is necessary to limit and automatically control the driving pressures. Experience shows that approximately 230,000 psi. is the required pressure on the shank area for carbon steel rivets and that airdriven yoke riveters, equipped with pressure-control valves, of the following capacities should be used:

⅝ in. rivets—20 tons
¾ in. rivets—35 tons
⅞ in. rivets—65 tons

The usual cold-driven rivet head is flat. However, an extensive theoretical study indicates that the most efficient form of head is a conical variation of the manufactured high button or acorn head (Fig. 2), which is specified in the *Tentative Specifications for Cold Riveted Construction* issued by the American Institute of Bolt, Nut and Rivet Manufacturers. The slightly conical shape of this driven head permits an easier flow of metal in driving and helps to center the die.

Specifications for bolt steel

Until comparatively recently, there were no standard requirements governing material to be used for structural bolts. However, rapid increase in the use of bolts for permanent connections made it desirable to remedy this deficiency in order to insure uniform bolt material of satisfactory physical characteristics. Consequently, ASTM, A 7, *Specifications for Structural Steel for Bridges and Buildings* were revised in 1939 to provide that structural bolts to be employed in permanent connections between parts fabricated of steel possess a minimum tensile strength of 60,000 psi., taken on the area at root of thread. The bolts must also meet the requirements of a cold-bend test on the unthreaded portion of the bolt.

In this test, specimens must not crack when bent cold through 180 deg. around a pin, the diameter of which

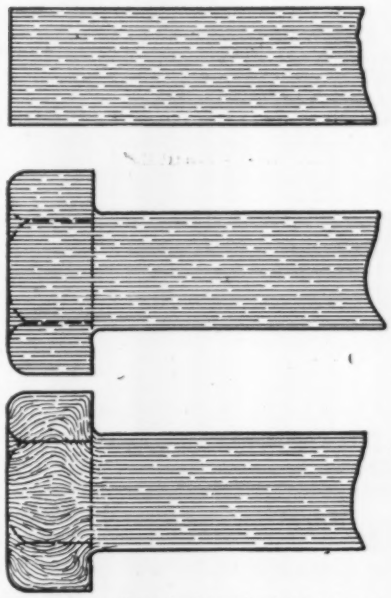


Fig. 3. Flow lines in bar stock (top) and in machined bolt (center) are rectilinear, but the fibers of a hot-forged bolt (bottom) curve into the head.

meets the following requirements:

Thickness of Material	Ratio of Pin Diameter to Thickness of Specimen
¾ in. and under	½
Over ¾ to 1 in., incl.	1
Over 1 to 1½ in., incl.	1½
Over 1½ to 2 in., incl.	2½
Over 2 in.	3

When bolts are used in structures subjected only to static stresses, it is of little importance whether the bolt is made by the hot-forging method or by being machined from the solid. However, for bridges, aircraft and other structures in which fatigue strength and resistance to impact is important, bolts should be made from heat-treated cold-rolled material or by hot or cold forging whereby the flow lines of the material in the head result in a fiber structure that offers maximum resistance to dynamic stresses, as such stresses are directed at right angles to the flow lines in the material of the bolt ahead (Fig. 3).

Where shear or bearing governs in bolted wind connections, the entire bearing length of the bolt barrel should be full-bodied, with all of the thread outside of the enclosed bearing, and in order that there should be no bearing on the thread, the bolts should be equipped with a washer under the nut. If such bolts are subjected to shear, tests show that the factor of safety on bolts figured at 10,000 psi. in shear on the full diameter is approximately 3.6. Standard structural bolts subjected to bearing will by test carry a load of at least 78,000 psi. before failure.

The process of cutting or rolling threads increases the yield strength of material in the threaded portion of the bolt by about 15 percent without materially reducing the ductility of the bolt as a whole. This added strength comes from the cold work done in threading, plus the circumferential reinforcement of the net area by the threads.

Locking devices have but little to do with bolt strength, but they are useful in view of the tightness requirements for bolted assemblies in structures subject to dynamic loads. The purpose of a lock nut is to prevent the nut from loosening.

While the usual method of specifying nut tightness is through the use of torque wrenches, a good workman who has developed the "feel" with a regular wrench will produce more reliable results than those secured with the most elaborate torque device. A properly tightened nut sets up a tension in the bolt equal to or greater than that produced by the design working load, and under this condition the bolt cannot fail from fatigue, as there can be no reversal in stress regardless of fluctuations in external load.

Combination rivet and bolt

During the past several years frequent use has been made of what is commonly called a "rivet-bolt," in which the principles of both a rivet and a bolt are combined in one fastening. Usually fitted with a lock nut, it consists of a standard rivet head with an axially ribbed grip section between the thread and the head. The root diameter of the ribbed section is slightly less than and the overall diameter of the ribbed section is $\frac{3}{32}$ in. greater than the nominal diameter of the rivet bolt. The over-all diameter, which is also the major thread diameter, is $\frac{1}{32}$ in. larger than the size of the hole.

When this type of bolt is driven into the hole, the ribs are deformed or else embedded in the wall of the hole causing the wall to become corrugated. The extent of this action is dependent upon the relative hardness of the materials in the bolt and the parts fastened.

Rivet-bolts have been used to a considerable extent in steel construction where rivets or turned bolts in drilled holes would ordinarily be employed.

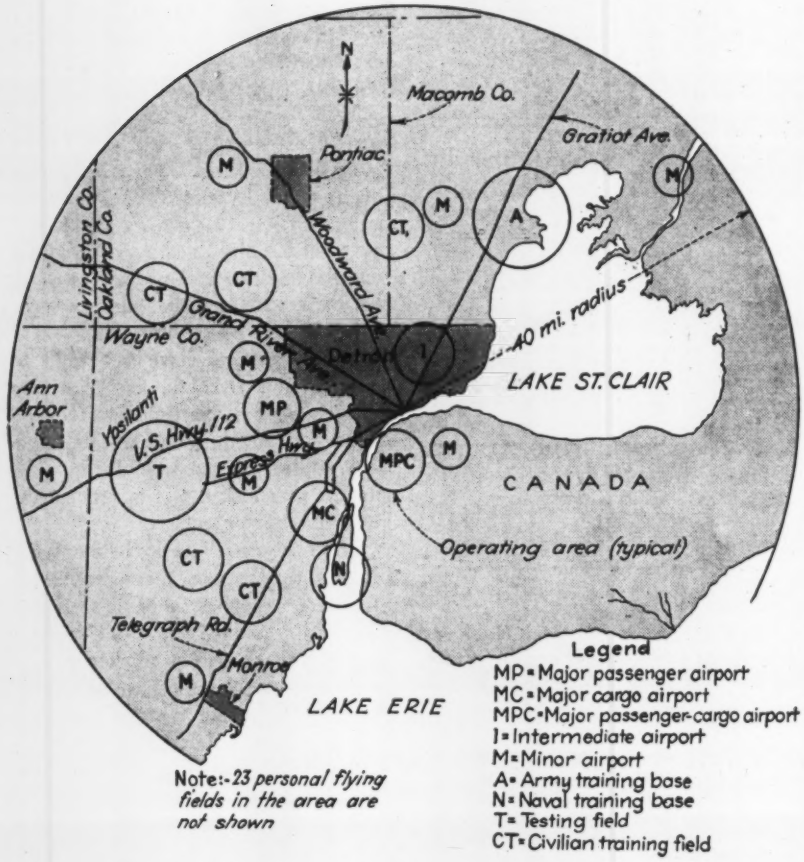


Fig. 1. Included in the 15-year development plan for air traffic in the Detroit metropolitan region are provisions for commercial passenger and cargo traffic, armed service bases, and private flying facilities.

Detroit Plans a 15-Year Airport Development

***Contents in Brief**—Long-range plans for airport development in Metropolitan Detroit and the surrounding region are based on the estimated 1960 air traffic. A total of 44 airports and landing fields are included in the master plan.*

BY 1960 THERE WILL BE 23 landing fields for privately-owned planes within a 40-mi. radius of downtown Detroit, Mich., according to the recently developed master plan for airport development in that area. Included also in the plan are nine minor airports, one major passenger airport, one major cargo airport, a large passenger-cargo airport, an intermediate airport and five civilian training fields. Also included in this over-all plan is an Army training base, a Naval training base and a testing field.

Not all of the proposed airports in the plan will have to be built new, however, since several existing ones in the region can be improved and integrated in the over-all plan. There are at present 26 airfields in the Detroit region, 24 of which are in the United States and two in Canada.

Existing airports lying within the United States include the five municipal airports located in Detroit, Pontiac, Ann Arbor, Ypsilanti and Monroe. There also is the Wayne County airport, the Army airfield at Selfridge, the Army testing field at Willow Run, and the Naval air base at Grosse Isle. In addition, there are at present 15 airfields for privately-owned planes, within the region.

Chief sponsor of the plan is the Detroit Metropolitan Aviation Planning Authority which is made up of representatives of Wayne, Oakland and Macomb counties, the city of Detroit and the Michigan Department of Aeronautics. In reality, the plan is the result of a comprehensive survey conducted by the associated consulting engineering firms of Smith, Hinchman & Grylls of Detroit, and Horner & Shifrin of St. Louis, Mo. Their findings and recommendations for airport development in and around Detroit are contained in a 173-page report, adopted by the planning authority last July.

Considerable detailed study and analysis necessarily went into compiling the report. Careful estimates were made of the probable air traffic for both 1950 and 1960. They covered commercial air traffic including passenger, cargo and mail service as well as facilities needed for privately-owned planes and the Army and Navy.

Among other things, it was necessary to determine the various sizes of airports that will be needed, their locations and the facilities that will be required to handle the estimated air traffic. Of paramount importance in the plan were the proximity of the different airports to the users, existing and future land uses, availability of suitable sites and the cost of construction and development. Also a prime necessity was that the plan should be extremely flexible to take care of not only immediate demands but increasing demands as the over-all traffic pattern is developed in the Detroit region.

Total yearly air passenger traffic in the Detroit region is estimated to reach 2,100,000 persons by 1950 and 5,333,000 by 1960. For the same years the amount of airmail is estimated at 8,800 tons and 13,000 tons, respectively, while air cargo is expected to reach 61,700 tons and 175,000 tons, according to the report.

Exclusive of the Army and Navy training bases, the testing field and the five civilian training fields, shown in Fig. 1, the investigations considered four basic types of airports. They are

(1) major airports, to be designed almost exclusively for scheduled air transport, (2) intermediate airports to serve large planes not operating under airline schedules, (3) minor airports, for smaller non-scheduled planes of all types, including large concentrations of personal planes, and (4) personal plane flying fields, for small planes used possibly in business, but largely for sport and recreation.

As recommended by the consulting engineers the physical features of the four basic types of airfields should have the following requirements:

Major airports—Runways in three directions (Fig. 2a) with the principal one not less than 6,000 ft. long (up to 10,000 ft. where feasible), located in the direction of the most prevalent wind of over 15 m.p.h. The other two main runways should be at least 5,200 ft. long, and all three should have parallel runways located from 1,000 to 5,000 ft. away. All six runways should be at least 150 ft. wide, and those designed for instrument landing should be 200 ft.

Intermediate airports — Three-directional runway pattern (Fig. 2b). Principal runway to be not less than 150 ft. wide by 4,500 ft. long, and secondary runways not less than 100 ft. wide by 3,750 ft. Over-all field dimensions to be at least 6,000 by 5,000 ft. with clearance from runway ends to field boundary to be 750 ft. for the main runway and 600 ft. for the other two.

Minor airports—Three directional runways, (Fig. 2c) with the principal runway at least 100 ft. wide by 3,000 ft. long, and the other two each 75 ft. wide by 2,300 ft. long. Minimum field dimensions to be 4,200 by 3,000 ft. Where such a field is designed to serve a large number of privately-owned planes, the runways should be centered in turf landings 600 to 800 ft. wide.

Personal plane fields—As recommended in the Detroit regional plan, main runways of personal plane flying fields would not be paved, but 50-ft. runway pavements should be constructed, as needed, along the landing strip. Two landing strips (Fig. 2d) are recommended, each 600 to 800 ft. wide and at right angles to each other. The usable, or operational, length of the principal strip should be a minimum of 75 ft. by 2,000 ft., and that of

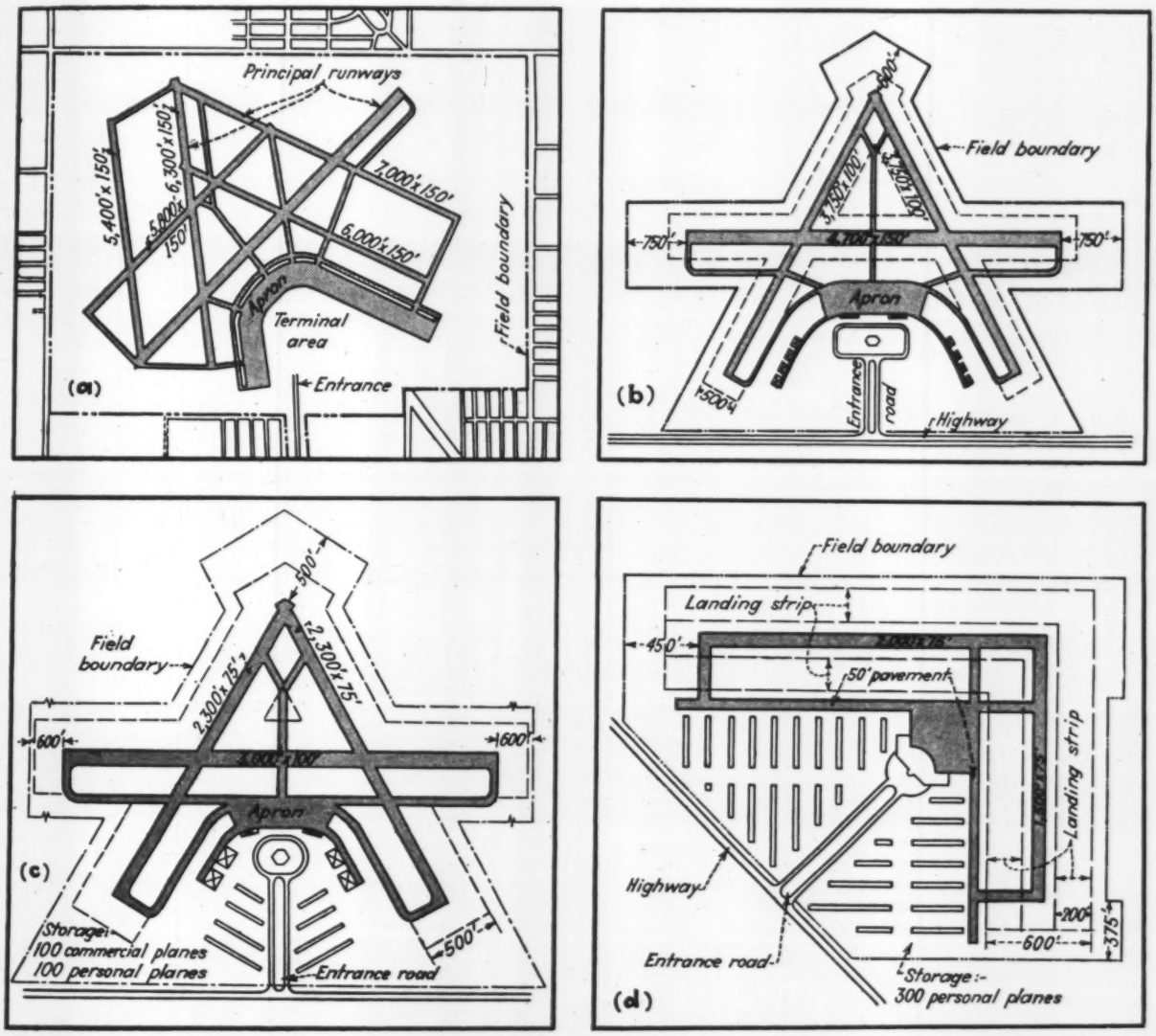


Fig. 2. Typical major airport design includes six runways of the parallel type (a), also tangential and parallel layouts with central terminal areas. Other basic types include intermediate airports (b), minor airports (c), and personal flying fields (d).

the other strip 75 ft. by 1,500 ft. Minimum field dimensions should be 2,900 by 2,250 ft. with larger areas provided as necessary for plane storage space, taxi strips and service aprons.

Estimated peak hour capacities of the above described airports are: 35 contact operations or 30 for instrument flying, for the major airports; 35 for both the intermediate and minor airports; and 150 plane movements for the personal plane fields.

In locating the several airfields the following operating radii were observed: Army training and testing fields, five miles; Naval training field, four miles; major airports, intermediate airports and civilian training fields, three miles; minor airports, two miles; and personal flying fields, one mile.

Comparative costs of construction for several of the proposed airports are included in the consulting engineers' report, but ultimate costs will depend on the amount of service facilities provided at the different sites as well as the cost of land, materials and labor at the time of construction.

New Ventilating Equipment Installed for Hoosac Tunnel

Improved fans that double the volume of air exhausted from the Hoosac Tunnel in Western Massachusetts were put into service recently. This is the third major change in the ventilating system for that famous railroad tunnel since it was put into service in 1873.

First great railway tunnel to be built in this country, the Hoosac Tunnel is 4¾ miles long, 24 ft. wide and 22 ft. 8 in. high. It carries a double track line of the Boston & Maine R.R. under the Hoosac Mountains. Begun in 1855 but not completed until nearly 20 years later, the tunnel was driven from the two ends and from a shaft 1,028 ft. deep sunk to the mid-point of the tunnel from high up on Florida Mountain.

In the early days this open shaft, 15x27 ft. in cross-section, acted as a chimney through which the natural updraft provided the only ventilation for the tunnel. As traffic on the railroad increased, the resultant accumulation of gases made more positive ventilation necessary and a paddle-wheel type of fan, then in common use for mine ventilation, was installed at the top of the shaft. It had a capacity of 250,000 cu.ft. per min.

Although this fan improved conditions in the tunnel they were far from satisfactory, and in 1911 the tunnel was electrified. Since then, electric locomotives have been used to pull all trains through the tunnel, thus making it unnecessary for coal-fired locomotives to operate under full steam while in the tunnel.

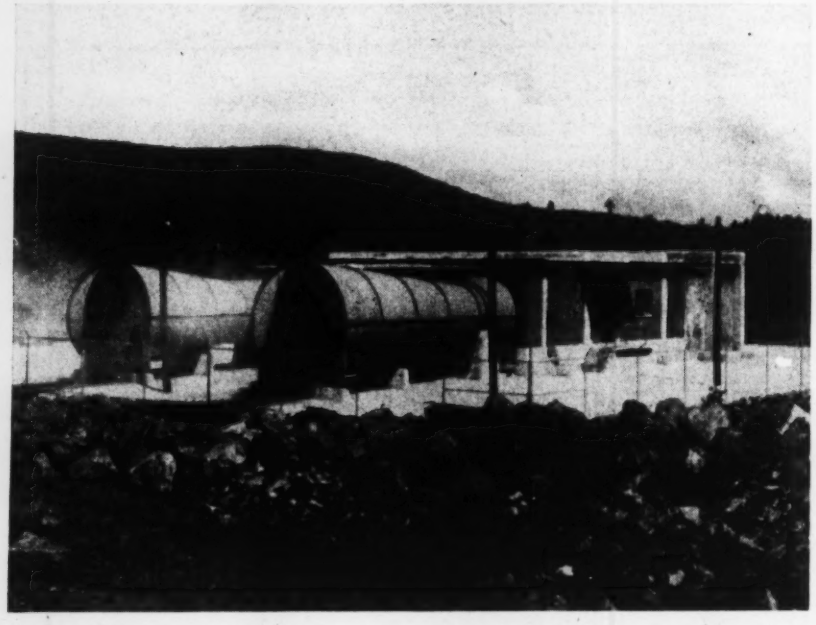
The new fans are of the propeller type. Each can exhaust about 270,000 cu.ft. of air per minute, giving a total capacity of 540,000 cu.ft. as compared with 250,000 cu.ft. for the old fan. Both fans, operating together, can change completely the tunnel air in about 25 minutes, at high speed, or 35 minutes, at low speed. They have features that give them even more advantage over the former fan, in that their driving motors can be operated at two speeds, and the propeller blades can be pitched in seven different positions, similar to the variable pitch propellers of airplanes.

The changes of motor speed and the variable pitch feature assure greater efficiency of operation, adapting the fans to changing resistance and atmospheric conditions in the tunnel and to variations in available horsepower in the driving motors.

The fans and their two 100-hp. motors are housed in a new brick and concrete structure at the top of the ventilating shaft. They are to be operated by remote control from one of the B. & M. operating towers at North Adams, Mass., four miles away.

Special electrical devices will give warning in the operating tower of any electrical or mechanical disturbance at the fan station that might interfere with their operation. Motor and drive shaft bearings, for example, are equipped with automatic oiling devices, but should a bearing become overheated the motor would be stopped and that fact would be recorded at the control tower. Track walkers in the tunnel will report by phone any atmospheric conditions that may require alteration of the speed or pitch of the ventilating fans.

Installation of the new ventilating equipment was under the direction of T. G. Sughrue, chief engineer of Boston & Maine, and D. M. Burckett, electrical engineer. Contractor was W. W. Wyman, Inc., Shelburne Falls, Mass.



Ventilating fan house for the Hoosac Tunnel of the Boston & Maine R. R. New exhaust fans have been installed at the top of the tunnel's central ventilating shaft.

Cable-Stiffened Suspension Bridge Developed Through Engineer Board Research

William G. Grove
Bridge Consultant, Engineer Board, Fort Belvoir, Va.

***Contents in Brief**—Out of the extensive military bridge research at Ft. Belvoir there emerged at the end of the war a suspension span in which stiffening is supplied by wire cables instead of the conventional trusses. Extensive study and test, including investigation with a 60-ft. model of a 600-ft. span, showed the structure to be unusually rigid. Complete designs were made and contracts let for a 460-ft. span to be built at West Point, when the end of the war caused cancellation of the project. Details of the model study and of the West Point design are presented in this article.*

AMONG the many engineering studies conducted by the Engineer Board of the Army Service Forces during the recent war is the model investigation of a cable-stiffened type of suspension span in which the structural steel stiffening trusses or girders of the conventional suspension design are eliminated and replaced by diagonals and cables made of prestressed galvanized steel wire ropes. As an outgrowth of the studies, designs were made for a 460 ft. span for a site on the U. S. Military Reservation at West Point, N. Y., where full-scale testing could be carried out, and construction contracts actually were let when the end of the war caused the project to be abandoned. The design, however, seems significant enough that a brief account of the model studies and a description of some of the structural details that were proposed for the West Point bridge may be of interest to the bridge profession.

In conventional suspension bridges, the stiffening trusses are very uneconomic members, since they carry no dead load, only about 20 percent of the live load, and yet account for about 50 percent of the weight of the steelwork. If they could be eliminated through some means that would at the same time insure an even roadway without noticeable wave action under traffic and without distortion of the parabolic curve of the cable (which are the functions of a stiffening truss), a saving should be possible. From a military point of view, a saving in weight would, of course, be highly desirable.

Since it was recognized that the deflections in cable-stiffened spans, both vertical and transverse, might be greater than those produced in truss-stiffened spans, the first studies, on a 1:100 two-dimensional model of a 600-ft. span, started at the Engineer Board in April, 1944, sought to ascertain the arrangement of the component parts that would reduce such deflections to a minimum. It was found that rigidity could be materially increased by the addition of a series of double diagonals in each panel in addition to suspenders, and that the use of hold-down cables, running the length

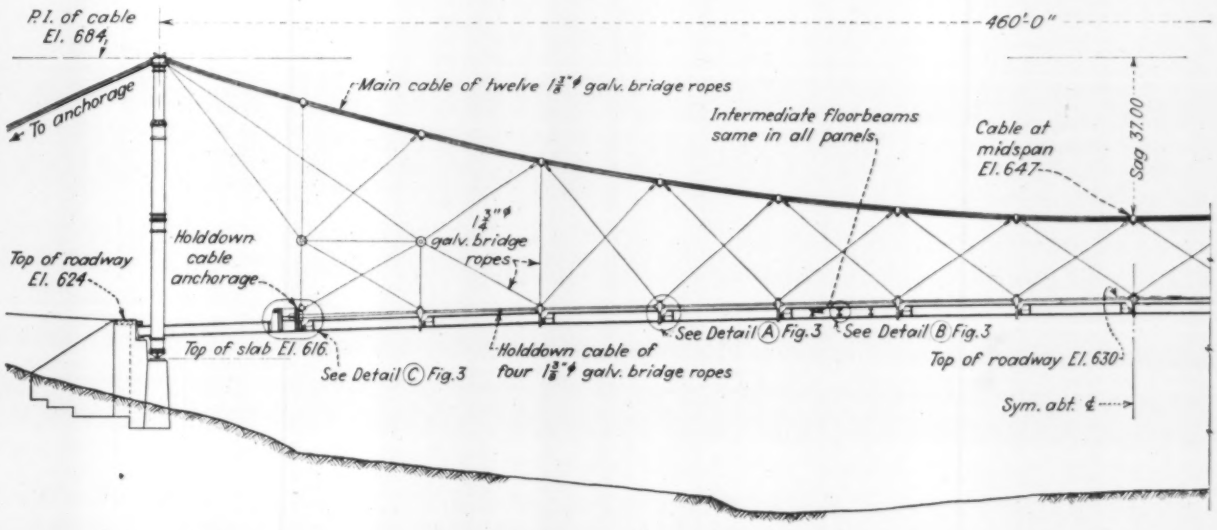

P.I. of cable El. 684
460'-0"
To anchorage
Main cable of twelve 1⅜" ϕ galv. bridge ropes
Intermediate floorbeams same in all panels
Cable at midspan El. 647
Sag 37.00
1¾" ϕ galv. bridge ropes
Holddown cable anchorage
Top of roadway El. 624
Top of slab El. 616
See Detail © Fig. 3
Holddown cable of four 1⅜" ϕ galv. bridge ropes
See Detail (A) Fig. 3
See Detail (B) Fig. 3
Top of roadway El. 630
Sym. abt. ℄

Fig. 1. Cable-stiffened suspension span is in reality a truss of tension members in which the main cables are the top chord while a set of hold-down ropes serves as the bottom chord. The hold-down ropes are anchored to the end panels of the floor.

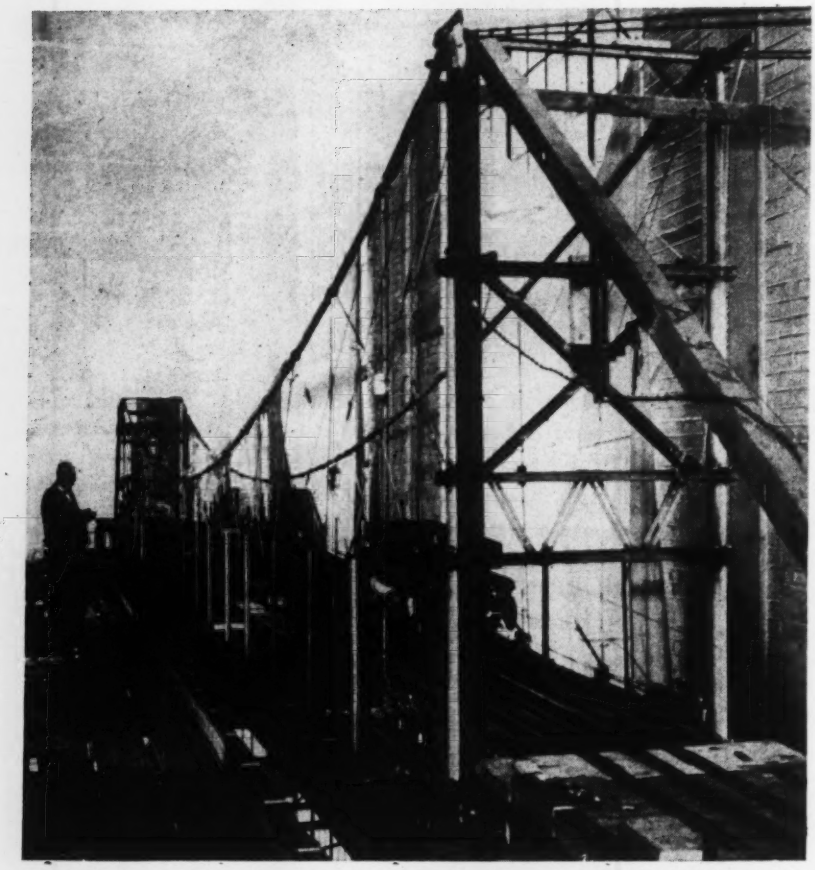


Fig. 2. Testing a 60-ft. long model of a cable-stiffened suspension bridge in the laboratories of the John A. Roebling's Sons Co. A miniature military tank simulates an 80 ton load on the prototype.

of the bridge on top of the floorbeams, also contributed to the rigidity and helped to distribute concentrated loads. Following this, a three-dimensional 1:20 scale model of a 200-ft. span was built to test the action of the entire assembly—cables, suspenders, diagonals, hold-down cables and floor. While certain things were learned, it was realized that the proportions of the model were not sufficiently accurate to determine quantitative values for the prototype, although qualitatively it was indicated that the deflections were not excessive, either vertical or transverse.

Model 60 ft. long built

In order to obtain a model which would give quantitative as well as qualitative results, the Engineer Board entered into a contract with the John A. Roebling's Sons Co. to investigate the practicability of the cable-stiffened type of bridge by the construction of a 60-ft. model of a 600-ft. span and to test this model for vertical, lateral and vibrating loads, the last simulating the effect of aerodynamic forces. The Roebling company started work in June, 1944, and as a preliminary made some studies of a pilot model (rebuilt from one previously used to determine a method for strengthening an existing bridge against aerodynamic forces), which included tests using various depths at the center of span. As the center depth, i.e., the distance between the main cables and the hold-down ropes, was decreased, it was found that the span deflection decreased up to a definite depth, and then as the depth was further decreased, the deflections increased. The critical depth thus determined on the pilot model was used in the design of the 60-ft. model.

This 60-ft. span model (Fig. 2) is designed so that the unit stresses are the same as those of the 600-ft. prototype, while the deflections of the model are $\frac{1}{10}$ those of the prototype for corresponding loads. The model is 60 ft. center to center of towers with a cable sag of 4.2 ft. The distance center to center of cables is 33⅝ in., and the towers are about 88 in. high. Each main cable consists of four aircraft cords ¼ in. diameter, each hold-down cable of four aircraft cords ⅛ in. diameter, and all diagonals and suspenders of one aircraft cord ⅛ in. diameter. The floor system is of steel shapes.

The live loads used in the tests consisted of a simulated 50-ton tank weighing 1,000 lb., and the same vehicle loaded with 600 lb. of lead weights, or the equivalent of an 80-ton tank. Lateral forces were applied to the span through ropes passing over sheaves and attached to 25 lb. lead weights. Each of these weights represented a horizontal load of 80 lb. per linear foot on the prototype, and by adding second and third weights forces of 160 and 240 lb. per linear foot were simulated.

A pulsation device was also constructed over one of the quarter-points of the span to introduce vibrations at the resonant frequency of the structure. The device was activated by compressed air, which was metered by magnetic valves controlled by a switch, which in turn was opened and closed by the motion of the model. A lifting force was applied against the floor structure simultaneously with movement upward and was released instantaneously when the model began to move downward. The forces were thus applied only when the model was moving upward at the location of the pulsator. A pencil indicator, connected to the model at the center of the span, recorded the wave motion of the bridge on a paper attached to a revolving drum. After an external pulsating force had been applied and the span vibrated to a large amplitude, the external force was removed and the recorder started, thus making a time and amplitude graph of the decreasing vibrations.

Stresses were determined by electric strain gages, and deflections were measured by level and rod. Movements at the tops of the towers were measured by Ames dials.

Many cable arrangements tested

During the period from November, 1944 to May, 1945, the 60-ft. model was tested under vertical, lateral and pulsating loads with about fifty different arrangements of the diagonals, verticals and hold-down cables. These investigations revealed a number of very pertinent facts in regard to the most advantageous arrangement of the

members in the profile. For example, it was found that the span was just about as stiff without the verticals as with them and, as a result, the verticals were omitted throughout the central portion of the span between the quarter points.

The action of the hold-down cables had a most pronounced effect on the behavior of the entire cable system under both vertical and lateral loads. The ends of the cables were fastened to the stringers of the end panels so that the 2,500 lb. to which the hold-down ropes were pre-loaded was transmitted through all the stringers, putting them in axial compression. At the panel points, one end of the stringers was fixed to the transverse floorbeam by a rigid connection, while the other end was hinged through a pin connection so that the local deflection at any panel point is taken care of by the hinge.

The hinge pins are located below the neutral axis of the stringers so that the 2,500 lb. compression in the stringers produces a bending upward of the entire floor system, making the actual compression stress in the top flange somewhat less than the compression in the bottom flange. As the live load passes over the span, it produces

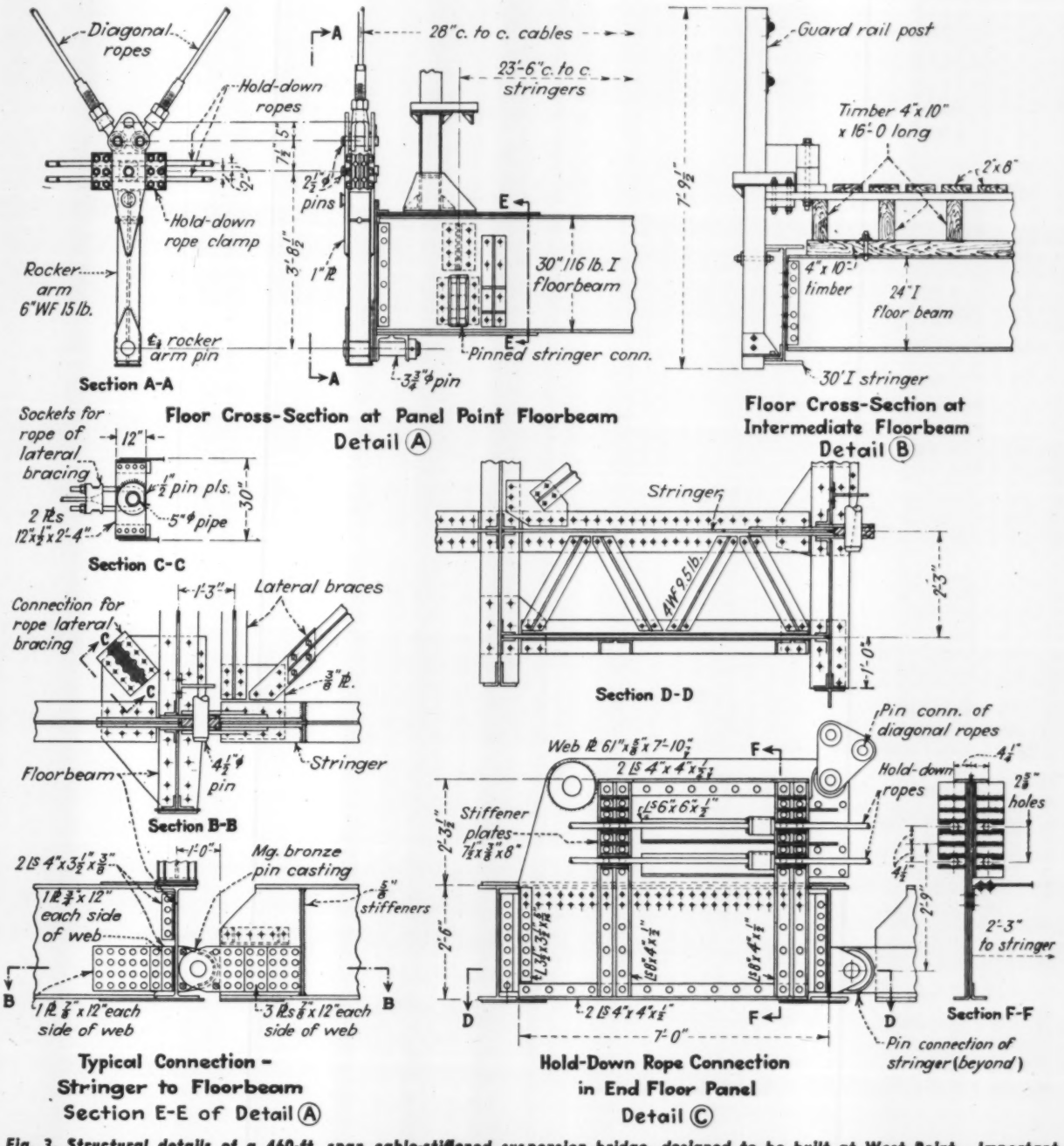


Fig. 3. Structural details of a 460-ft. span cable-stiffened suspension bridge, designed to be built at West Point. Important elements are the rocker arm connections of cables to floor at the panel points, the pinned connections of the stringers and the anchorage of the hold-down ropes to the end panel floor steel.

a live load compression in the top flange and a live load tension in the bottom flange of the stringers due to beam action. The live and dead load stresses in the bottom flange thus tend to neutralize each other instead of being additive. The combined action of the hold-down cables and stringers, together with the main cables, provided sufficient stability under lateral forces to justify eliminating parabolic wind cables, which initially had been installed under the deck.

When the pulsating force was applied to the unstiffened span, i.e. without diagonals or hold-down cables, the bridge vibrated with the wave in two segments and having a node at approximately the center of the span. The amplitude of the wave was about 5 in. When two diagonals on either side of the centerline of the span were added and the center vertical removed, there was still a two-segment vibration with a node at the center, but the amplitude of the wave was increased. As more diagonals were placed and verticals removed, the span vibrated in two-segment waves with a node at the center, but with reducing amplitudes, which diminished to about 2 in. When the last diagonals were placed at the ends of the span and the pulsating force applied, the node disappeared and the span vibrated with a wave in a single segment over the entire length of span, having an amplitude of about 1.7 in. With a complete system of double diagonals in each panel, it seemed impossible to get the span to vibrate in a wave of more than one segment. The cable-stiffened span is so stiff that in actual behavior it more nearly approaches ordinary truss action than suspension span action. Lt. Col. J. W. Beretta, who proposed the design, has, in fact, referred to the structure as a "rigid tension truss" bridge.

Design elements of a 460-ft. span

With these facts established by the model studies, the design of a full-scale bridge could be undertaken with confidence. A number of such designs were made for various span lengths from 150 to 600 ft. The design of a 460-ft. span, which had been planned for West Point, was the most advanced and may be described briefly.

In the design the span was suspended between two towers 68 ft. high. The straight backstays were anchored in rock outcrops. The roadway width was 22 ft., and the width center to center of cables was 28 ft. Each main cable consisted of twelve, $1\frac{3}{8}$ in. dia. galvanized prestressed bridge ropes, and each hold-down cable of four, while single ropes of the same size were used for diagonals and suspenders. The panel length was 28 ft.

For ease of erection, the individual panels were designed to be assembled as units on the shore side of the towers and rolled out to position on erection carriages. Each panel consisted of two main longitudinal members or stringers spaced 23 ft. 6 in. and assembled with two main and three intermediate floorbeams and lateral bracing. Attachment of each panel to the previously erected portion of the structure was to be accomplished by insertion of the two pins at the stringer connections. In the 23-ft. 6-in. x 7-ft. floor subpanel adjacent to the pins structure steel lateral bracing was used, while the remainder of the panel, 23 ft. 6 in. x 21 ft. was braced by wire cables.

In order to be consistent with the previous investigation, a wood floor was to be installed consisting of two layers of planking of longitudinal wood stringers.

At each panel point the floor was connected to the suspension system by means of a link, the lower end of which was pin-connected to the bottom of the floorbeam, while the upper end was pin-connected to the hold-down cable band which formed the intersection point of hold-down cable and diagonals. Thus, the link was free to rotate, and the unbalance in tension in the diagonals was taken by the hold-down cables and transferred by them into the floor steel of the hold-down cable anchorages near the towers. This arrangement obviated the necessity of installing a heavy bracket at each panel point to take this unbalance directly into the floor steel.

The investigation at the Engineer Board was conducted by the writer, working under Col. Carl W. Meyer and Lt. Col. J. W. Beretta, at that time director and deputy director of Technical Division No. IV of the Engineer Board. Brig. Gen. J. W. N. Schulz is president of the Engineer Board. The investigation at the Roebling plant was conducted by C. C. Sunderland, chief engineer; Blair Birdsall, assistant chief engineer; and their associates, Leroy Nixon, G. W. Jaggers, Harold W. Hills, J. M. Herrmann, M. C. Meade, H. K. Preston, and Prof. N. J. Sollenberger of Princeton University.

During the investigation, contacts were made with other bridge engineers to ascertain the results of any previous independent investigations that had been made on the cable-stiffened type. It developed that several investigations had been made along similar lines. Two may be noted, one described by the staff of Modjeski and Masters in *Engineering News-Record*, Oct. 23, 1941, in which the importance of diagonals in suspension spans is emphasized, and another described by Prof. George A. Maney, of Northwestern University, shortly after the failure of the Tacoma Narrows Bridge, in *Engineering News-Record*, April 24, 1941, in which certain conclusions are given which have been corroborated by the investigations at the Roebling plant and the Engineer Board.

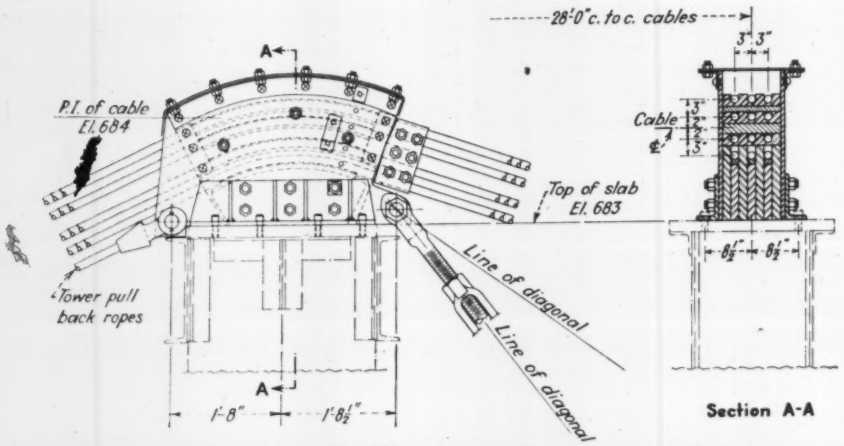


Fig. 4. Tower saddles of the cable-stiffened suspension span accommodate the twelve wire ropes of the main cables and include connections for two main span rope diagonals and two side span pull-back ropes.

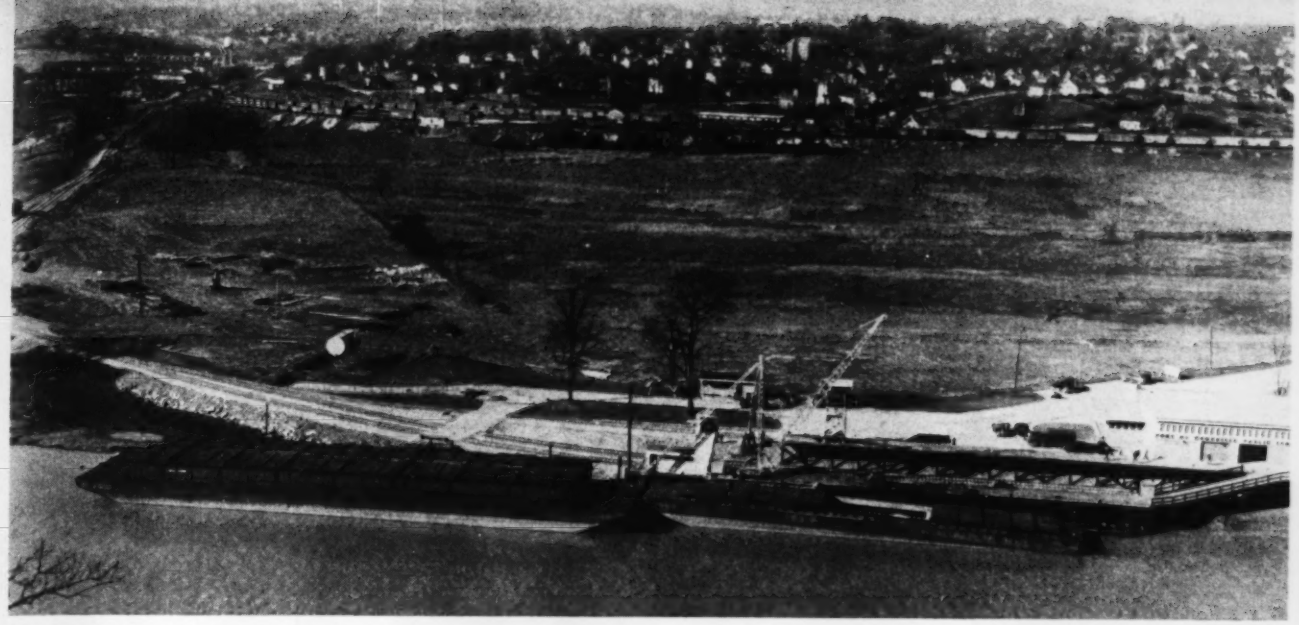


Fig. 1—Inland waterway terminal at Knoxville built and operated for the public by the Tennessee Valley Authority.

Navigation on the Tennessee River

Part II Channel Improvements and Shipping Facilities

C. T. Barker
Chief, River Transportation Division, Commerce Department
Tennessee Valley Authority

***Contents in Brief**—The 650-mile long, 9-ft. deep navigation channel on the Tennessee River is virtually complete. Facilities for shipping include private and public terminals for handling package and bulk freight. Greatest future need is for joint rates between river and land carriers to realize full advantage of river transportation. A previous article by Mr. Barker titled "Current Trends in River Commerce" appeared in the February 21 issue, vol. p. 285.*

AS FAR BACK AS 1824, the improvement of navigation on the Tennessee River was regarded by the federal government as one of the most urgent internal improvement projects of the day. The great rapids at Muscle Shoals in northern Alabama created an almost complete barrier to commercial navigation, and numerous less difficult rapids and shoals made long-haul navigation on a commercial scale excessively high in cost.

In 1832 a railroad was built around Muscle Shoals and later a canal, but neither of these effectively solved the problem at that point. Also, in the nineteenth century, locks and lateral canals were built at Riverton, Ala., and Elk River Shoals; and prior to 1933 locks and dams were constructed at Muscle Shoals and Hales Bar.

These improvements provided year-round minimum depths of 4 ft. from Paducah, Ky., to Florence, Ala., 2 ft. to Chattanooga, and 1½ ft. to Knoxville. They were of some value to the commerce of the day, but by the 1920's it became quite apparent that the improvement of the Tennessee had not kept pace with the 9-ft. channel improvement of the Ohio and the lower Mississippi. Accordingly, the River and Harbor Act of 1930 authorized the permanent improvement of the river for 9-ft. navigation, primarily by the construction of a system of low dams. However, before construction was far advanced, this project was supplanted by that of the Tennessee Valley Authority.

It is reasonable to assume, therefore, that practically all of the increase in traffic on the Tennessee, outlined in Part I of this article, *ENR*, Feb. 21, 1945 vol. p. 285 is due to the improved navigation facilities, provided under the TVA act of 1933. A continuous chain of lakes, formed by one low-lift dam at Florence, Ala. and nine comparatively high dams at other points, at which the lock lifts vary from 34 to 72 ft., provide an unusually good navigation channel.

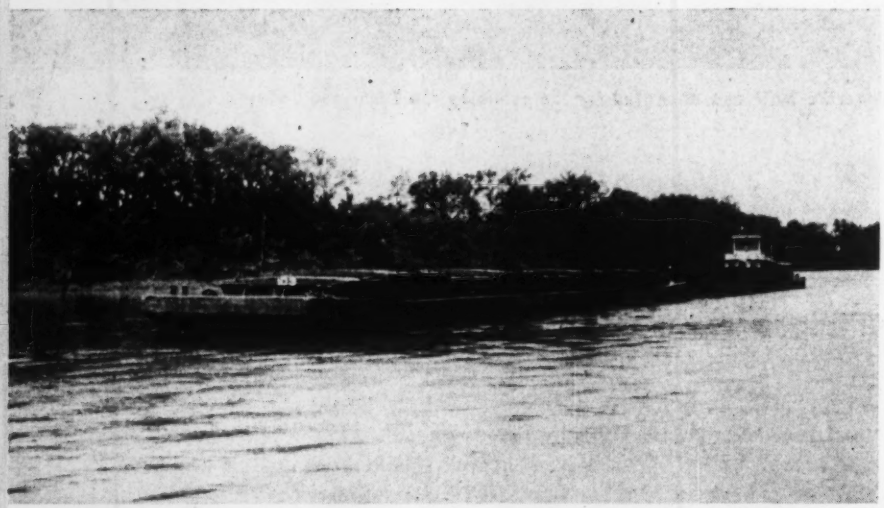
Two of the locks and dams, Wilson Dam and the low Dam No. 1, just downstream, and the locks at Wheeler and Hales Bar dams, were designed and constructed by the U. S. Army Engineers prior to the advent of TVA. These locks vary in size from 265 x 60 ft. at Hales Bar (opened to navigation in 1913) to 360 x 60 ft. at Wheeler

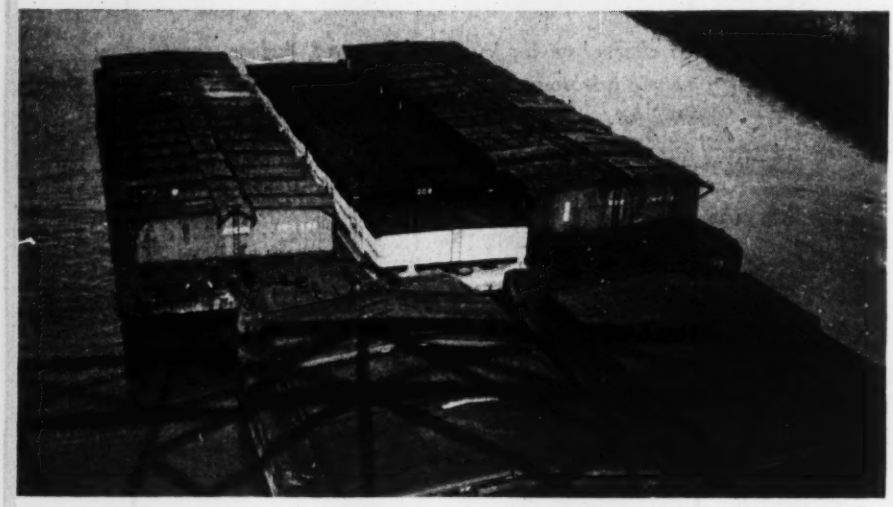
Dam. Of the six locks constructed by TVA, all but the one at Kentucky Dam were designed by the Army Engineers. The Kentucky and Pickwick locks in the lower river, have chamber dimensions of 600 x 110 ft. and those at Guntersville, Chickamauga, Watts Bar, and Fort Loudon are 360 x 60 ft.

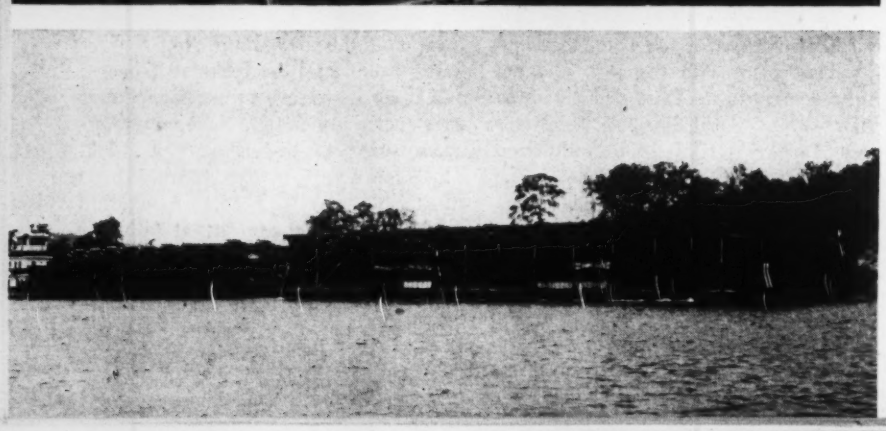
Larger locks are desirable where traffic is heavy to avoid "breaking-up" tows to pass the locks and to reduce lockage time. The 360 x 60 ft. size will pass any towboat or barge now in service on the inland waterway, and will pass at one time four of the popular-size 1,000-ton barges, which are 26 x 175 ft. At each of the dams, space is reserved for construction of an additional lock when traffic warrants it.

Broad, deep lakes provide navigation channels adequate for heavily loaded barges. However, immediately below each of the locks, except at Kentucky Dam, it has been found economical to do some dredging to complete the waterway instead of providing higher pool levels. As much as 700,000 cu. yd. was moved at some of the projects. Dredged channels are a minimum of 11 ft. deep and 300 ft. wide, ample for vessels of 9-foot draft when under way.

Fig. 2—Grain barges (top) package cargo (center) and military vehicles (below) move on the Tennessee River. Tanker barges and packaged petroleum products are also important items of river commerce. In peace time barges deliver automobiles along the waterway.







Safe and economical navigation

There are several reasons why the improved Tennessee River now provides exceptionally safe and economical navigation. In a total length of river of 650 miles there are only ten locks, or an average of one lock in 65 miles which compares with an average of 24 miles per lock on the upper Mississippi and 21 miles per lock on the Ohio River. The pools have such a large cross section of flow that there is no perceptible current except immediately below the locks; and, because of close regulation of flood flows, the pool levels are remarkably stable.

Channel depth will always be adequate for 9-ft. draft vessels regardless of dry seasons. Numerous safety harbors have been constructed along the entire length of the navigation channel. Greater than usual width and depth of the channel makes for greater propulsive efficiency for tow-boats. Records show that complete freedom from ice may be expected in 19 years out of 20.

Standard clearances for new and reconstructed bridges are 57 ft. vertically above normal pool or 40 ft. above maximum flood of record, whichever requires the higher elevation of structure; and horizontal clearance of 350 ft. downstream from Chattanooga and 300 ft. upstream. A few existing bridges have not been modified to meet these clearances.

Channel marking

As on other inland rivers, a system of lights, buoys, and other navigation aids has been established and maintained by the U. S. Coast Guard. These aids provide for safe navigation 24 hours a day over the full length of the river from Paducah to Knoxville. It has been the Coast Guard's announced purpose to establish a marking pattern whose excellence and completeness will set a new standard for western rivers. The extent to which this has been accomplished is remarkably illustrated by the fact that pilots are regularly

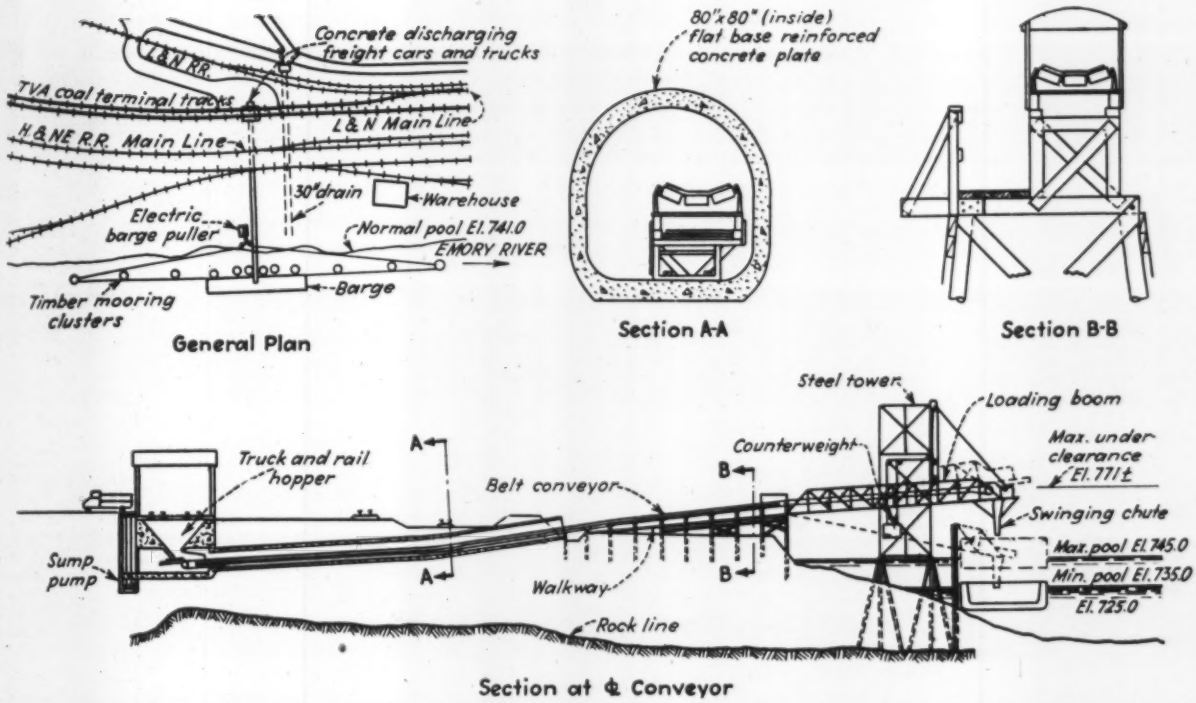


Fig. 3—Coal transfer terminal built by TVA at Harriman, Tenn. It is available for use by private shippers on published schedule of rates and regulations.

handling tows safely night and day over new pools where the channel does not bear even a remote resemblance to the old river.

Permanent service bases have been established by the Coast Guard at Chickamauga Dam, at Sheffield, Ala., near Wilson Dam, and at Paris Landing near Paris, Tenn. The Coast Guard is interested also in the security of all vessels and navigation structures and operates patrol boats on the river.

Navigation charts in color

Charts have been prepared by the U. S. Army Engineers for the entire river showing the established sailing line and the buoys and lights marking the channel. The TVA has a program for the preparation of multi-colored charts showing the depth of water in various parts of the reservoirs, the sailing line and channel marking system, the safety harbors, and a great deal of other information that does not appear on most charts. These much more informative TVA charts have been completed for Chickamauga and Guntersville reservoirs and the lower half of Watts Bar reservoir and have proven most valuable in locating channels to mineral deposits and for location of docking facilities.

The characteristics of modern freight carrier equipment on the inland waterways are worth some explanation at this point. The general public, and too many engineers, still think of river transportation in terms of the high-sided, shallow-draft, stern-wheel packet boats of the Mark Twain era, transporting passengers and perhaps 200 to 300 tons of freight per boat. This type of vessel has almost completely disappeared, except as an excursion novelty, and in its place is the typical flotilla of steel barges pushed by a diesel or steam-powered screw-propeller towboat.

There are many types and sizes of steel barges, depending on the services to be performed. Bulk commodities requiring no protection from the weather are hauled in open-top barges, and other bulk commodities and packaged goods needing protection from the weather are hauled in barges having watertight top hatches or cargo houses. The dimensions of barges now in most common use are 175 x 26 x 11 ft. (cargo capacity, 1,000 tons), four of which, or three and a towboat, fit into a 360 x 60 ft. lock. Another popular size of barge is 195 x 35 x 11 ft., with a capacity of 1,500 tons. Some of the common type barges are shown in Fig. 2.

The Tennessee River is now served by about eighteen barge lines, both private and for-hire, not including a number of sand and gravel concerns. The private carriers are owned by milling, oil, brick and tile and other firms which transport their own commodities. Seven of the for-hire barge lines are common carriers of general freight at published rates (like the railroads and many commercial truck lines), four operating throughout the river, one each as far as Guntersville and Chattanooga, and one a short distance above the mouth. Some offer to carry shipments of any size, some only in bargeloads. Remaining for-hire carriers transport bargeload shipments for selected shippers instead of the general public and bargain on the rate to be charged.

Private terminal facilities

A large number of private terminal facilities have been built on the Tennessee River since the improved channel has been made adequate for deep-draft navigation. These include light bulk oil terminals for the Gulf Refining Co. and the Texas Co. Grain terminals have been constructed by flour milling interests at Chattanooga and Decatur while at Guntersville grain is unloaded into two elevators from which it is distributed to the southeastern area. At two points, coal producers have terminals for transferring coal from trucks by gravity into barges.

On the lower Tennessee River, there are many small private landings that are used for the shipment of forest products, and there are a few such landings on the middle and upper sections of the river. Some of these landings are served by floating derricks, but most of them have no handling equipment other than lumber chutes. In the last few years, about 40 new landings or terminals of this type have been provided on the Pickwick, Wheeler and Guntersville pools. There are private terminals all along the river at which sand and gravel dredged from the river are transferred from barge to rail or to stockpiles.

TVA terminals

There are numerous prospective shippers with a variety of freight in comparatively small volume who cannot afford to provide their own terminal facilities. To serve this large part of the shipping public that could not otherwise obtain the benefits of river transportation, the Tennessee Valley Authority has recently constructed public-use river terminals at Knoxville, Chattanooga, Guntersville and Decatur. Facilities are available for handling nearly all types of freight with the exception of liquids in bulk, perishables and livestock.

These terminals are operated at present by the TVA and are open for use of all the public with published charges, rules and regulations uniformly applicable to all. Each terminal has both railroad and highway connections, a freight house in which a comparatively small volume of freight may be stored temporarily, and a derrick of about 10-tons capacity. Freight in packages may be handled either by pallets or four-wheel industrial trucks.

Since the loading platform is flush, or nearly so, with the barge main deck at normal water stage, in many instances packaged freight may be loaded or unloaded without the use of the derrick. Freight carried loose in bulk (such as grain) is transferred by derrick between railroad cars or truck and barge. The general features of the public-use terminals are shown in Fig. 1.

TVA recently constructed a terminal at Harriman, Tenn. on the Watts Bar pool, for unloading of coal from railroad cars and trucks into river barges, as shown in Fig. 3. This terminal is open to general public use at published rates. The TVA also has constructed a coal unloading terminal at the Watts Bar steam plant so that the coal supply for that plant can be delivered by river. Some 190,000 tons has been moved on the Tennessee and Ohio from Caseyville, Ohio, to this plant.

At Sheffield, Ala., an all-purpose public-use terminal, owned by the city, is operated by a common-carrier barge line. This terminal has a freight house and derrick.

Inland shipyards

Of the many important wartime developments along the river, two of the most interesting were shipyards at Decatur, Ala., one well established before the war and the other constructed a short time after the attack on Pearl Harbor. These yards made an important contribution to the nation's war effort in the construction of seagoing cargo ships, tugs, cargo barges, derrick barges and other types of vessels. The improvement of the Tennessee for deep-draft navigation made possible the utilization of the labor supply, materials, and equipment at inland points to build war craft that, otherwise, would have been loaded upon the already congested coastal shipyards.

Future needs of river commerce

Many inquires from industrial and civic groups have been received by the TVA in regard to the location and design of possible additional private and public-use terminals and public warehouses on the river. A considerable increase in privately-owned carrier, terminal and warehouse facilities is anticipated in the post-war period.

Probably the principal things needed for further development of economical transportation on the Tennessee are: more comprehesive common-carrier barge-line services, joint barge-rail and barge-truck rates, and a greater awareness on the part of business men of the opportunities for transportation savings.

No serious attempt has been made as yet to obtain comprehensive barge-rail joint rates, and ordinarily the establishment of such rates is a long drawn out procedure. It is anticipated, however, that reasonably soon much greater cooperation between barge lines and trucks will largely solve the joint-haul problem. The revived movement of peacetime goods through ordinary trade channels that will surely develop now that war time limitations on goods and equipment have eased will add greatly to the total flow of traffic on the improved river.

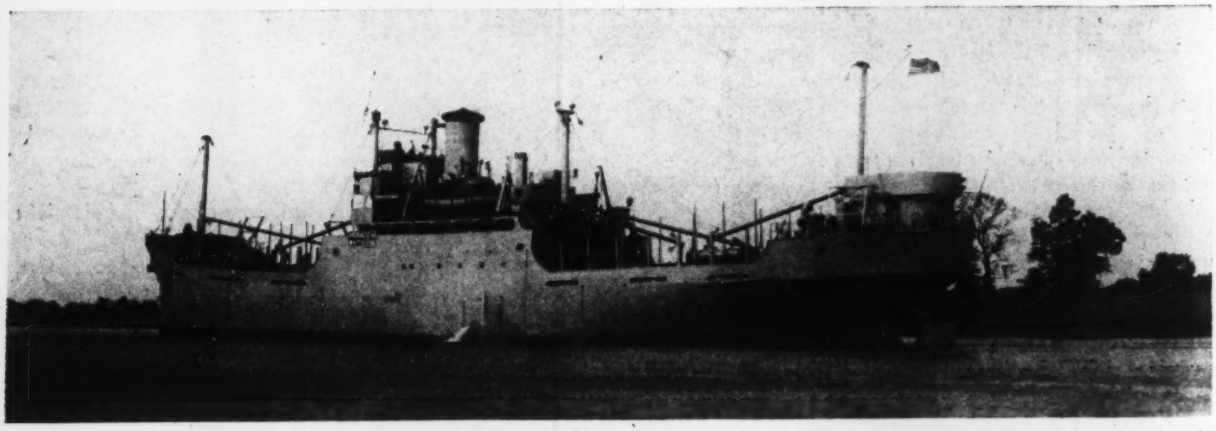
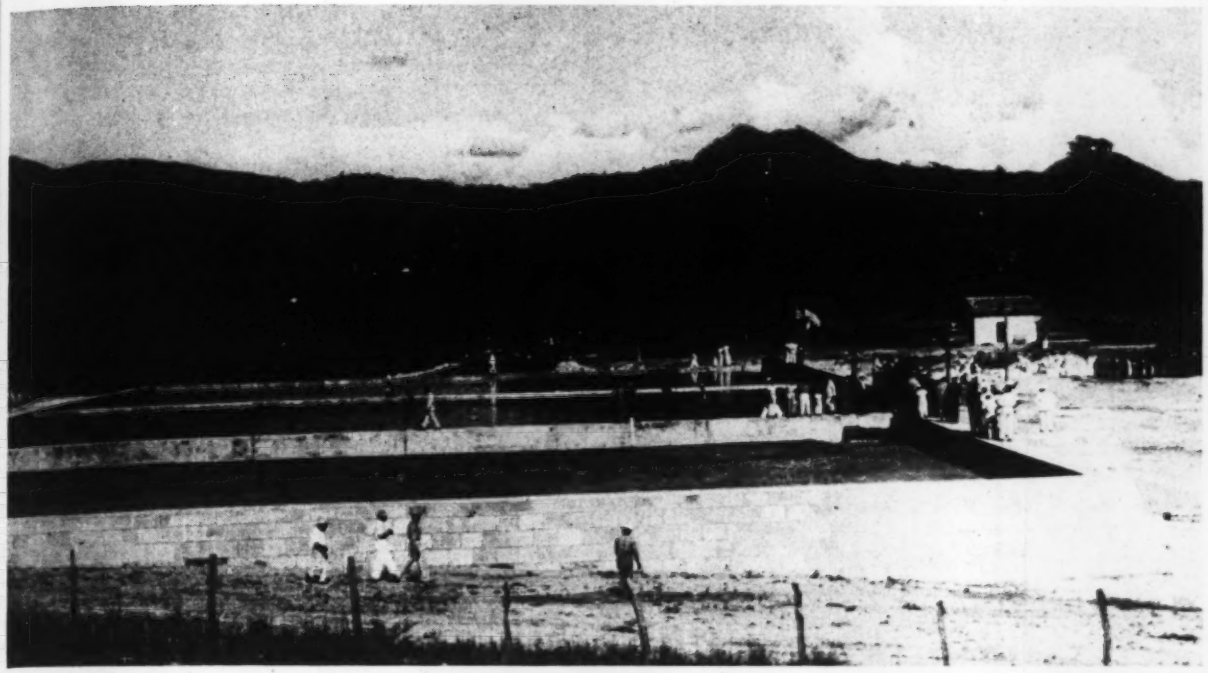


Fig. 4. Ocean-going freighters 258 ft. long were built at Decatur, Ala., and taken to the Gulf via the Tennessee, Ohio, and Mississippi rivers to serve with the Maritime Commission fleet.



Slow sand filter units for Tegucigalpa, Honduras, water supply system have gravity walls built of native stone.

Colloidal Turbidity of Tropics Water Removed by Slow Sand Filters

***Contents in Brief**—Slow sand filters constructed with local materials helped to solve problems of gross pollution and high colloidal turbidity in the water supply for a major section of Tegucigalpa, capital city of Honduras. Gravity-type walls of the filter basins are of cyclopean masonry faced with cut stone.*

To produce a better quality of water for the Comayaguela section of Tegucigalpa, capital city of Honduras, a slow sand filtration plant of 2-mgd. capacity recently was installed. This treatment was necessary because of the gross pollution of the supply and for the removal of a high colloidal-type turbidity.

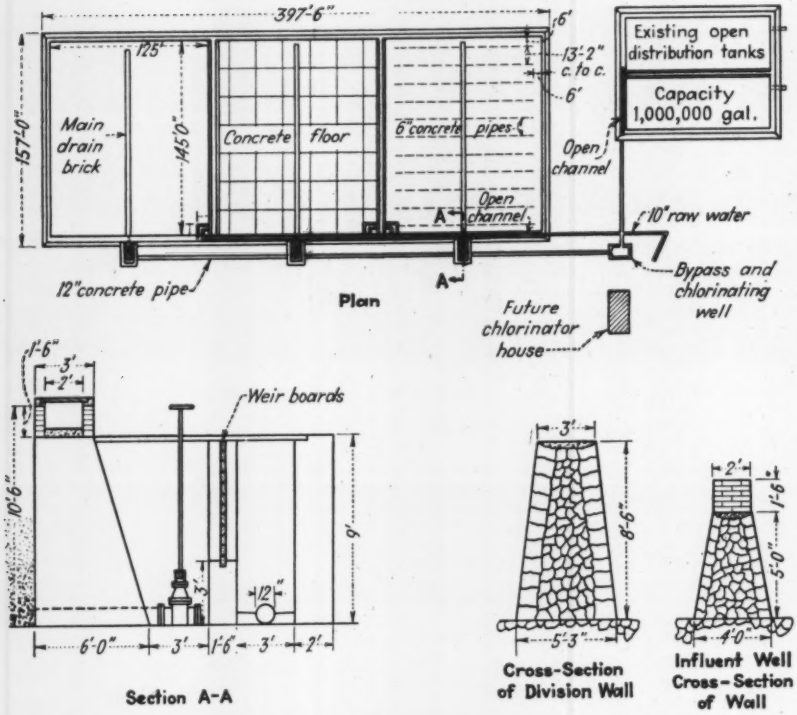
Tegucigalpa, with a population of about 50,000, has two water supply systems, each providing water to one of the two main sections of the city. Supplying water to Tegucigalpa proper, the Picacho system uses as its source two mountain streams whose waters are brought to the city through a conduit. Before reaching the city this water is used for the development of hydro-electric power; after chlorination it constitutes the domestic supply for some 30,000 people.

The second system supplies the Comayaguela section of the city with water from a 10-mg. reservoir located about 5 mi. southwest of the city on a main stream. While the watershed of this stream is of unknown size and is sparsely populated, several small villages are located along the stream's banks at its far reaches. Most inhabited land of the watershed is used for grazing of cattle, while the stream is used for washing, bathing, and other domestic purposes. Bacteriological tests showed this water to be highly polluted most of the time.

Tegucigalpa, located in interior of Honduras, gets its water supply from highly turbid and polluted mountain watersheds whose areas are virtually unexplored.

From the impounding reservoir water flows by gravity through a combination canal and tunnel to a settling reservoir of 1.75 mg. capacity. It then flows by gravity through a compound 12- and 10-in. cast iron pipe line to the filter units and distribution reservoirs. Capacity of this existing pipeline was found by direct measurement to be 2 mgd.

During the rainy season the raw



Details of slow sand filters of Tegucigalpa reflect influence of availability of local materials. Note dry-laid brick topping of influent well wall.

water of the Comayaguela system becomes highly turbid due to the rapid runoff and the presence of a volcanic calcium stone in the watershed. This turbidity, which is colloidal in nature, could not be completely removed by plain sedimentation and subsequent filtration. Turbidity samples collected after the filtration plant was put into operation clearly brought out this fact, as throughout an entire rainy season turbidity in the filter effluent averaged about 30 ppm., while during the same period turbidity of the raw water varied from 200 ppm. to about 50 ppm.

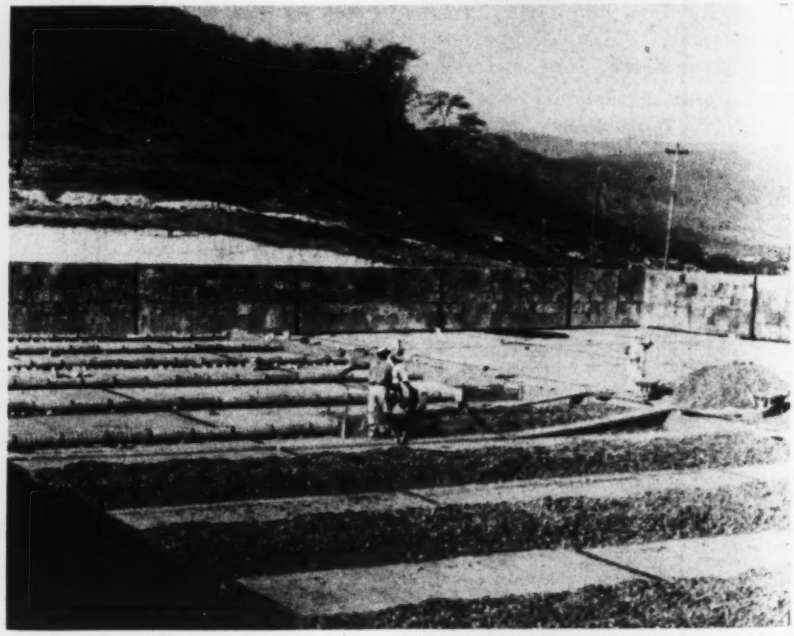
To establish a basis for the slow sand filter installation, a small experimental plant, based on the design rate of 2.5 mgd. per acre of filter surface, was constructed. This experimental filter operated during 52 days of the 1943 rainy season, after which it became necessary to clean it. Several series of bacterial samples collected during this period showed an average bacteria removal of 96 percent, while the average coliform index of the effluent was 6.0.

The amount of filter area required for the final installation was based on the same design rate as that used in the experimental filter, and on the capacity of the pipeline. Thus, it was necessary to provide 0.8 acres of filter area and, in addition, a reserve unit. On this basis, three units of 0.4 acres each were designed.

Local materials used throughout

In planning construction of these filters it was necessary, because of transportation difficulties, to consider the availability of local materials. The design therefore was based on the utilization of materials which could be obtained close to the site.

Interior of gravity walls is cyclopean rubble masonry; exterior is square-cut granite gneiss blocks.



Concrete pipe underdrains being covered with coarse crushed stone prior to placing filter media, which had to be hauled from streambed sources 7 to 8 miles distant from the plant site.

The filter basins were designed with gravity-type walls constructed of cyclopean masonry faced with square blocks of a granite gneiss common to that section of the country. The walls were subsequently plastered on the inside face. The floors of the basins were constructed of a 12-in. stone masonry base over which 3½ in. of concrete was placed. The underdrain system for the filters consists of 6-in. cement pipe discharging into a main drain constructed of red brick and stone masonry.

These main drains discharge into clearwater wells, the overflow from which flows to collecting wells, through which the main concrete pipeline conveying the water to the distribution reservoir passes. This concrete clearwater pipeline is composed of 10 and 12-in. concrete pipe. The filter media consists of crushed river stone and river sand obtained from the beds of streams in the locality. Transportation of materials was accomplished with trucks, numerous ox-carts and mulepacks.

Stilling baffles of raw-water inlets are gravity walls of cyclopean masonry faced with cut stone and with top 1½ ft. built up of dry-laid red brick.

Stone facing was major phase

Stone for the masonry walls of the filters was obtained from a nearby quarry, cut and shaped at the quarry by hand and then transported to the site. The facing of the walls with cut blocks of stone was a major phase of the project, because some 22,000 blocks average 14 to 16-in. square were necessary. Much of this stone was hauled to the site by ox-cart, supplementing the trucks available. Black clay encountered in some portions of the wall foundations necessitated a 14 ft. depth in those areas.

The government of Honduras placed a stone-crushing plant at the disposal of construction forces. River boulders, obtained from nearby streams were crushed for use under the filter floor and as the coarse filter media. The stones were screened by hand to obtain the necessary gradation.

Filter sand hard to find

Obtaining sand filtering media in sufficient amount presented the greatest problem of the construction, but after examining the characteristics of sand in several streambeds, sources were located which were considered satisfactory. The river sand finally obtained had an average uniformity coefficient of 2.54 and effective size of 0.28 mm. Some 7,800 cu. yd. of sand and 3,100 cu. yd. of crushed stone was necessary for the filter media and for other phases of the construction.

These materials were brought to the site by ox-cart and mule pack. Sand was hauled from points as much as 7 or 8 miles distant from the job site. Concrete pipe was manufactured in the Honduran government pipe plant from materials furnished by the project.

Rate of flow through each filter can be controlled by a 10-in. gate valve in the clearwater basin, but weir-type stop planks are also provided. These planks, 6 in. in width, are removed to keep the flow constant as loss of head increases. Gages are also provided in each filter tank and each clearwater basin to indicate the loss of head in each filter.

Operating results

Effluent from the filters discharges into a combination bypass and chlorinating well. It is planned that the municipality will provide chlorinating apparatus to treat the effluent before it is discharged into the distribution tank. Suitable piping is also provided to bypass raw water through the distribution tank for chlorination before discharge into the distribution reservoirs.

After the filters were placed in operation, a regular sampling schedule was set up for the determination of coliform bacteria and turbidity. Only the presumptive test was used in coliform determination. From July 17, 1944, to March 7, 1945, eighteen bacterial samples showed the following results:

	Raw Water	Filtered Water	Tap on System
37° C. count (Aver. 18 samples)	210	110	130
B. Coli index	325	2.45	4.2

Construction of this filter plant was carried out as a project of the Inter-American Cooperative Health Service, a unit of the Institute of Inter-American Affairs, with the governments of the United States and Honduras participating.

Total cost of the project to the sponsoring agency was $117,150. In addition, the government of Honduras contributed some $24,254 in the form of rental value of trucks, stone crushing equipment, concrete mixers, the value of land, and other services of purely local origin.

Maj. Peter C. Karalekas, Sn. C., was chief engineer in Honduras for the Institute of Inter-American Affairs, of which Col. H. B. Gotaas is president: C. I. Sterling, Jr., is chief engineer of the Washington office. Resident engineer and project manager for the Comayaguela filter plant work was Marco Gulio Canales.

Highway Officials Discuss Problems Growing Out of New Responsibilities

***Contents in Brief**—Chief among the subjects that came up for consideration at the recent meeting of the American Association of State Highway Officials were the following: Proper allocation of funds for highway work in cities, bids on work let to contract, size and weight limits for trucks, use of consulting engineers for highway studies, county road work done by force account, highway materials, minor bridge designs and contraction of concrete pavement. Answers given to specific questions addressed to the Public Roads Administration also are included in the following report of the meeting.*

A MULTITUDE of problems covering highway design, administrative procedure, materials, and methods of construction came up for active discussion at two open-panel sessions at the recent annual meeting of the American Association of State Highway Officials in Oklahoma City, Okla. Summaries of the issues raised and of the comment thereon are given in the following, which supplements the general report of the meeting published Feb. 14, vol. p. 253.

Funds for urban highways

No other problem will require more administrative discretion, warned Spencer Miller, Jr., chairman of the New Jersey Highway Commission, than that of the distribution of allotments of funds for urban highway construction.

Cities have been starved for so long that considerable pressure can be expected from many sources for new street and highway construction. To keep from "frittering" away available funds will require careful interpretation and administrative acumen, he predicted.

Cities must be made aware of the value of origin and destination surveys, declared Mr. Miller, and five-year or even ten-year plans for urban improvement must be set up so the cities can see that their recommended highway projects form a part of the over-all plan. This, he said, will do much to relieve pressure which may be brought to bear for the early completion of certain projects.

C. H. Sells, superintendent, New York Department of Public Works, declared the policy of his department was that no urban highway project would be approved unless it provided increased capacity or flexibility of traffic. Special talent is needed for this work and New York has created a planning bureau to deal with the many problems, he said.

Mr. Sells said further that New York State intends to develop a master plan for each city of any appreciable size in which the proposed arterial routes will be integrated with the city's plans for slum clearance, industrial development, city highways and other civic improvements. So far, he said, New York City is the only city that has progressed far enough in its planning for his department to determine the necessary program of urban highway construction.

John L. Herber, chief engineer, Pennsylvania Department of Highways, agreed with Mr. Sells that no part of a master plan should be undertaken unless the entire plan is deemed feasible and one capable of being prosecuted to a successful conclusion. A big problem, he said, is convincing the cities of the order of priority in undertaking the various projects.

Contract bid prices

In a discussion of the relation of contractors' bids to engineers' estimates, several examples were given of close conformity of contract bid prices with engineers' estimates. There was considerable discussion, but no agreement reached, on whether 1940 or 1941 prices should be used as a base or estimating work. H. S. Fairbank, deputy commissioner, PRA, said his agency favored using 1940 prices since that was the last year in which prices were not affected by the war. Average construction prices during 1945 were 50 percent above those of 1940, but compared to those of 1941 they have risen only 41 percent, he said.

Spencer Miller, Jr., of New Jersey, ventured the opinion that it was of little importance which year was selected as a base for contract prices. New Jersey anticipates that future bid prices will run not more than 35 to 40 percent above those of 1941, and if so, the state is going ahead and let contracts for the work, he said.

E. N. Rogers, director, Alabama State Highway Department, reported an unusual amount of contractor interest in a recent $2,500,000 highway and bridge construction letting in his state. A total of 306 bids were received on the 15 projects that were advertised. To avoid uncertainty in the price of steel, since the steel companies refused to guarantee prices beyond the date of letting, the highway department assumed all up-grading of steel prices beyond that date, he said.

Anticipated bridge costs

The Oregon State Highway Department has come to the conclusion that average bridge and highway contract prices should not be more than 50 percent greater than 1941 prices, according to R. H. Baldock, state highway engineer. Since the end of the war, Oregon has let some $4,000,000 worth of this work at an average contract price of 41 percent above 1941 prices, he said.

Similarly, R. H. Wilson, office engineer, California Department of Public Works, reported that $20,000,000 worth of highway work has been placed under contract in that state since last November. In general, contract prices have run from 35 to 40 percent higher than those of 1940, with many bids being offered on each project advertised. California's chief trouble is that of getting residents to vacate property already secured as right-of-way.

M. L. O'Neale, chief engineer, West

Virginia State Road Commission, advocated reducing the size of highway construction projects in order to widen the field of bidders, and to shorten the time of completion, thus minimizing the effect of rising wages over longer periods. Breaking down a million-dollar project where feasible into two or three contracts will develop more contractors by helping the little ones get a start, he said.

Agreement with this policy was voiced by C. M. Hathaway, engineer of construction, Illinois State Highway Department, who added that a contractor is more apt to take a smaller contract that can be completed in three or four months than one which will extend into 1947. However, said Mr. Hathaway, the proposed amount of primary, secondary and urban highway construction should produce a variety of contracts, many of which will be suited to the small contractor. Furthermore, said he, now is the time to separate the grading, structures and paving contained in the large projects into separate contracts of smaller size.

Size and weight of trucks

In response to a plea by O. L. Kipp, chief engineer, Minnesota Department of Highways, for greater uniformity of limiting sizes and weights of highway trucks, H. S. Fairbank, of the PRA announced that the association's Committee on Highway Transport, has agreed on the following limitations, which will be submitted by letter ballot for approval by the state highway departments:

Limiting width of trucks and busses, 102 in.; length of single unit trucks, 35 ft.; three-axle busses with a steerable rear axle, 40 ft.; tractor and semi-trailer, 50 ft.; other combinations of trucks and full trailers, 60 ft. The recommended limiting height is 12½ ft. Single axle loads are held strictly to 18,000 lb.

For group axle loadings, the committee recommends a table of allowable weights based on the spacing of axles. The coefficient C used in the formula for computing these weights has been assigned a value of 650 when the total length (L) is less than 18 ft. and 750 when it exceeds 18 ft. The break in allowable gross weight for a loaded length of 18 ft. has been ironed out to give a progressive increase in total weight. For axles spaced 8 ft. apart or less, the total gross load is limited to 32,000 lb. Mr. Fairbank expressed the opinion that the above recommendations will form a basis of uniform truck sizes and loadings on which early agreement can be reached not only between the state highway departments but also by truck manufacturers and operators.

Use of consultants opposed

H. E. Hilts, deputy commissioner, PRA, expressed the opinion that state highway departments should make their field surveys and prepare plans and specifications without the help of consulting engineers except under conditions of grave necessity. The awarding of large contracts for such services to consulting firms is apt to react unfavorably to the state highway departments, he said.

However, continued Mr. Hilts, the employment of consulting engineers for this work has met with considerable success in the past on large bridges and on certain road-building projects. In view of this, PRA district engineers stand ready to give favorable consideration to any such special situations in the future.

County force-account work

Considerable discussion was centered on the construction of federal-aid secondary roads by county forces. Such practice does not seem advisable in general, said Mr. Hilts, in view of the demonstrated economy and efficiency of the contract method of highway construction. Nevertheless, said Mr. Hilts, due to the minor character of improvements often involved, the PRA will consider county force-account work on secondary roads in a favorable light, when recommended by the state highway departments, based on the following requirements:

That the cost is reasonable and the county is organized and equipped to perform the work without the necessity of purchasing additional construction equipment not needed for its normal operations. That the character of the improvement is economically unsuitable for construction by contract. As an example, Mr. Hilts, mentioned light grading and surfacing, or the installation of drainage culverts as a part of stage construction.

Despite years of research, engineers still are faced with a serious problem in determining the treatment of bituminous binders or mineral aggregates to prevent the stripping action of water, declared T. E. Stanton, materials and research engineer, California Department of Public Works. Recent investigations in California have led to the development of a somewhat new approach to the problem, he added.

It has been known for some time that bituminous surfaces, particularly those constructed with liquid asphalts, may perform successfully throughout the winter, yet fail abruptly during one or two days of hot summer weather, declared Mr. Stanton. Such failures are particularly acute where the surface has been tightly sealed or even covered with a new surfacing. Therefore it has long been suspected that moisture vapor condensing in a bituminous mixture is potentially more destructive than liquid water. In view of this, the highway department has devised laboratory tests of bituminous mixtures in which water vapor is introduced, provision is made for condensation and then the effect on stability is measured. Correlation of the tests with known performance in the field has been good, Mr. Stanton said.

Secondary bridges

One of the big problems confronting bridge designers today, said Raymond Archibald, chief of the bridge division, PRA, is that of designing bridges for secondary highways that can be built with available funds.

Certain economies can be effected by using less durable materials and by minimizing the amount of shop fabrication of steel structures. As an example, Mr. Archibald, cited a recent case in which no shop fabrication was required for the steel stringers in an I-beam bridge. The plain beams were cut to length at the mill and shipped direct to the bridge site, with bearing plates and bracing being welded in place in the field. As a further economy, the usual steel expansion dams were omitted and a guard rail of the wide-face type was used in lieu of the usual shop-fabricated steel handrail, he said.

N. E. Lant, bridge engineer, Louisiana Department of Highways, suggested an economical design for secondary bridges up to 30-ft. span. It involves the use of plain rolled steel beams, cut to length at the mill, shipped

direct to the site and spaced 6 ft. apart in the completed bridge. In lieu of the conventional concrete pier, each beam can be supported on a structural steel or concrete pile driven in place, he said.

There is a growing tendency for cement companies to furnish cement-dispersion and air-entraining cements even when they are not required to do so by the specifications, declared R. V. Reagel, engineer of materials and tests, Missouri State Highway Department. Since it is known that excessive amounts of these additives reduce the strength of the concrete, such practice should be curbed except in cases where needed. T. E. Stanton of California agreed with Mr. Reagel, and suggested the admixtures be added at the mixer when needed.

Michigan's concrete pavements

Based on observations of Michigan's four-year old, 17-mile cement concrete test pavement, the problem with concrete pavement placed in the summer is not so much expansion as it is contraction, said Harry C. Coons, chief engineer of the Michigan State Highway Department. This test pavement was placed during the summer in sections up to 2,700-ft. long between expansion joints. During the winter, transverse contraction cracks which occur at intervals of 110 to 120 ft. open so wide as to lose the interlock between the aggregates.

In view of these and other observations, said Mr. Coons, his department concludes that expansion joints are not needed except at structures and intersections in concrete pavements placed in the summer time. For concrete placed after Sept. 1, Michigan plans to install expansion joints at not less than 400-ft. intervals and not more than the end of the day's pour. This will apply to both unreinforced and reinforced pavement. Contraction joints will be spaced at 100-ft. intervals, filled with a precompressed filler and reinforced for the transfer of live load shear across the joint with 1¼-in. x 15-in. steel dowels spaced 12 in. apart.

Many questions raised

A great number of questions were raised by the highway officials, in both open-panel sessions of the convention, relative to the speedy inauguration and implementation of the new highway program. Some of the more timely questions, with answers by officials of the PRA follow:

What is the status of the proposed interstate system of highways? The tentative integrated system containing 37,000 miles of proposed interstate highways will be sent in map form to the state highway departments immediately for their approval.

Is it permissible for counties to set up their improvement plans under the new program without regard to what percentage of the total mileage involves county, federal-aid secondary or feeder roads? Yes; the amount of traffic, social and economic needs should govern the selections.

Questions of policy were actively discussed by these PRA officials at the AASHO meeting. (Left to right): H. S. Fairbank, deputy commissioner, Department of Research; H. E. Hilts, deputy commissioner, Department of Design; L. I. Hewes, chief, Western Headquarters; and E. F. Kelley, chief, Division of Research and Tests.

How can the federal approval of proposed projects be expedited? Telegraphic approval by PRA will be given when needed and when possible. However, several program descriptions, of late, have been too meager for final approval.

What is the federal procedure for reimbursing states for costs of right-of-way? Such funds are reimbursable after the state has bought the right-of-way and filed a claim with PRA. This can be done on a progressive basis, similar to the reimbursement for contract construction. The procedure can be simplified by filing costs of right-of-way, preliminary engineering and awarding of contract, all at one time.

How should benefits to railroad companies be calculated in regard to proposed railroad grade crossing elimination? The determination of benefits to railroads is complex and difficult to compute under the present law. However, the PRA hopes to be able to announce a simplification of this procedure soon.

Can regular federal-aid funds be used on a 50-50 matching basis to build railroad-highway grade separations not included in the regular grade separation program? Yes. In that case the government would be paying only 50 percent of the cost instead of 100 percent.

Is it possible to relax the necessity of contractors making such extensive reports to PRA on the costs and amounts of the basic 15 construction materials? This information is being secured at the request of the Bureau of Labor Statistics, Department of Labor, which has the authority to demand it in case the PRA is unable to secure it from contractors.

Should state highway departments contribute more to city planning studies? Since the Federal-Aid Highway Act of 1944 places the responsibility for coordination of intercity routes with urban and primary highways, it behooves the highway departments to take a greater interest, financially, in coordinating city planning. Much of this work is eligible to come under the 1½ percent fund set up under the new program.

Is it possible for the PRA to draft a set of standard plans for low-cost bridges on the secondary highway systems? Yes it is possible, but it is doubtful if such a move will fit in with several of the states' current practices.

Critical Flow in Circular Conduits Analyzed by Nomograph

F. T. Mavis
Head, Department of Civil Engineering
Carnegie Institute of Technology, Pittsburgh, Pa.

ANALYSIS OF PROBLEMS relating to critical flow in culverts, sewers and drains is aided by tables of critical depth and critical velocity in circular conduits. In themselves, however, the tables do not provide as rapid and convenient a tool for computing as does the accompanying nomographic chart, which also covers the problems of sequent depths and hydraulic jump.

The theory of hydraulic jump in circular conduits is well established and is adequately validated by laboratory experiments (see *ENR* Dec. 29, 1938, p. 815). According to that theory, for conditions of critical flow in a channel with a free water surface the velocity head at any given section equals one-half the hydraulic mean depth of the wetted section, where the hydraulic mean depth is the cross-sectional area of flow divided by its water-surface width.

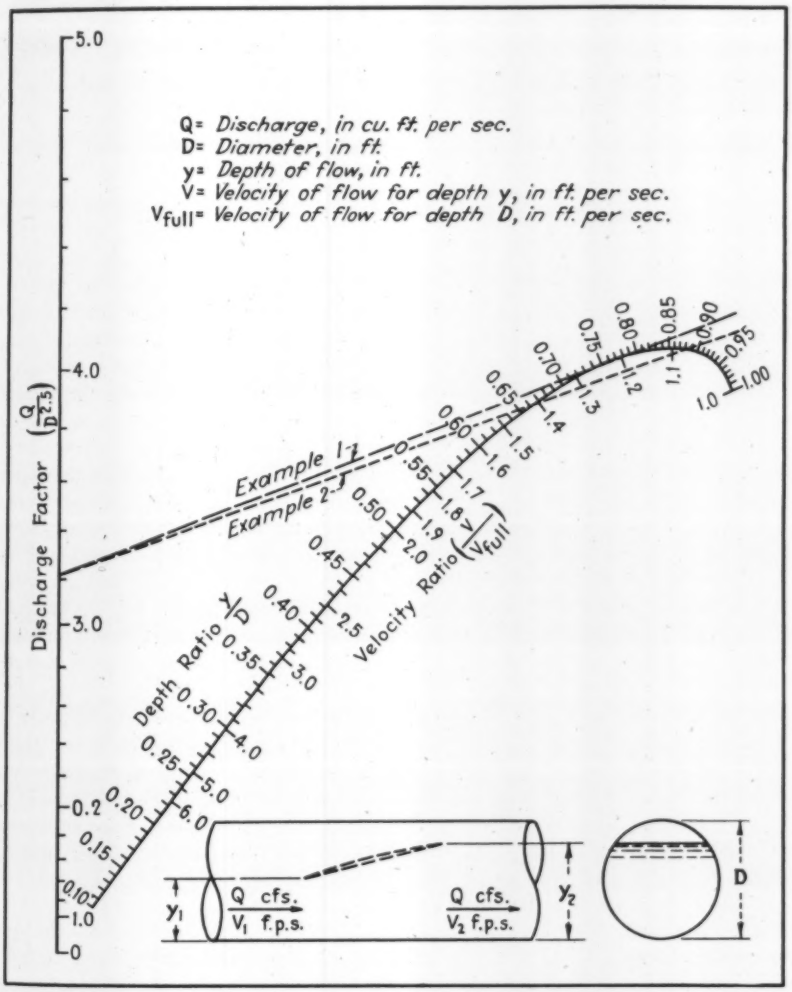


Fig. 1. Nomograph speeds analysis of critical flow conditions in circular conduits, indicating critical depth, critical velocity, sequent depths and hydraulic jump.

Water flowing in a conduit at supercritical velocity V_1 and depth y_1 can be made to pass through the hydraulic jump to a corresponding subcritical velocity V_2 and corresponding depth y_2 (Fig. 1). Conditions for equilibrium are such that the "pressure-plus-momentum" at Section 1 is exactly equal to the pressure-plus-momentum at Section 2.

For Section 1, let the following be assumed:

y_1 = depth of flow in ft.
V_1 = velocity in ft. per sec.
A_1 = cross-sectional area of flow in sq. ft.
$\bar{y}_1$ = vertical distance in ft. from the centroid of the wetted cross-section to the water surface

Also, let y_2, V_2, A_2, and $\bar{y}_2$ represent the corresponding variables at Section 2. For both sections

Q = the rate of flow in cu. ft. per sec.
w = unit weight of water, 62.4 lb. per cu. ft.
g = acceleration of gravity, 32.2 ft. per sec^2.

Then "pressure-plus-momentum" at Section 1 is

$$w A_1 \bar{y}_1 + \frac{w}{g} Q V_1 \qquad (1)$$

The corresponding "pressure-plus-momentum" at Section 2 is

$$w A_2 \bar{y}_2 + \frac{w}{g} Q V_2 \qquad (2)$$

Replacing each velocity term by its proper Q/A, the equation of pressure-plus-momentum necessary for hydraulic jump or for critical flow is

$$w A_1 \bar{y}_1 + w \frac{Q^2}{g} \frac{1}{A_1} = w A_2 \bar{y}_2 + w \frac{Q^2}{g} \frac{1}{A_2} \qquad (3)$$

A nomographic chart for solving

this equation is shown in Fig. 1. On the nomograph, the velocity ratio has been drawn on the same curved scale as the depth ratio, since it is a unique function of the latter.

To use the diagram for a given quantity Q, flowing through a pipe of diameter D, the discharge factor, $\frac{Q}{D^{2.5}}$, is calculated first. A straight line is then drawn through the corresponding point on the discharge factor scale to intersect the scale of depth-ratios, y/D. One of three conditions then exists.

In the first of these conditions the straight line is tangent to the depth-ratio scale, the point of tangency being the value of y/D corresponding to the critical depth. At the point of tangency one can also read the velocity ratio for that flow.

If, as in the second case, the straight line intersects the curve at two points as a secant, the water will jump from the depth and velocity corresponding to the lower depth-ratio to the depth and velocity corresponding to the higher of the two depth-ratios.

The third case is that where the straight line cuts the curve only once, indicating that the pipe will flow full below the hydraulic jump. When this occurs it is evident that air must be supplied to the conduit or the phenomenon will become merely a sudden expansion and cease to behave as a hydraulic jump.

The following numerical examples illustrate the use of the diagram:

Example 1. Find the critical depth and critical velocity in a circular pipe 3 ft. in diameter discharging 50 cfs.

$$Q/D^2 = 50/(3)^2 = 5.55$$

$$V_{full} = 5.55/0.785 = 7.07 \text{ ft. per sec.}$$

$$Q/D^{2.5} = 5.55/\sqrt{3} = 3.21$$

(Note the order of steps in the foregoing calculations to obtain velocity full and discharge factor. When calculations are made in this order, separate tables of areas and 2.5-powers are of little help.) A straight line through discharge factor 3.21 on Fig. 1 is tangent to the curve at depth ratio 0.77. Hence, the critical depth, y_c, is $0.77 \times 3.0 = 2.3$ ft. The corresponding velocity ratio is 1.21 and the critical velocity, V_c, is $1.21 \times 7.07 = 8.55$ ft. per sec.

Example 2. A discharge of 50 cfs. flows at a depth of 2.0 ft. in a circular pipe 3 ft. in diameter. Find the velocity of flow above the hydraulic jump and the depth and velocity of flow below the jump. From Example 1, the velocity full is 7.07 ft. per sec. and $Q/D^{2.5} = 3.21$.

Above jump, $y_1/D = 2.0/3.0 = 0.67$
From Fig. 1, when $y_1/D = 0.67$, $V_1/V_{full} = 1.4$ and velocity at Sec. 1 is $1.4 \times 7.07 = 9.9$ ft. per sec.
A straight line through $Q/D^{2.5} = 3.21$ and $y_1/D = 0.67$ intersects the curve at $y_2/D = 0.88$ and $V_2/V_{full} = 1.08$.

Depth of flow below jump, $y_2 = 0.88 \times 3.0 = 2.64$ ft.

Velocity below jump, $V_2 = 1.08 \times 7.07 = 7.65$ ft. per sec.

Accurate Trigonometric Leveling Uses Ordinary Transit

O. B. Misz
Field Engineer, Bureau of Reclamation,
Phoenix, Ariz.

Quick and accurate long-range leveling can be accomplished by a method of observing angles on the vertical arc of an ordinary transit to the same degree of precision as horizontal angles are determined in precise triangulation work. Based on the principle of angle measurement by repetition, the method uses the transit's leveling screws as a second vertical motion. No special skill on the part of the instrumentman is necessary.

In determining the vertical angle between two stations, the plate is clamped so that the telescope is as nearly as possible in line with one pair of leveling screws. The leveling screws are then loosened and the instrument turned to point at the target with the plate approximately level transversely.

With the instrument thus oriented, the front and rear leveling screws are manipulated to bring the plate into an inclined plane as steep as the leveling screw threads will permit. If the target is above the horizontal plane of the instrument, the front of the plate is raised; if below, it is lowered. The telescope is then leveled by means of the vertical motion and the vertical vernier reading is recorded as "Direct-O" (see accompanying "Sample Field Record").

Angle measured by repetition

Measurement of the angle then proceeds as follows:

Bring the center cross hair exactly on the target. Record the vertical vernier reading as "Direct-1". This will finish one "direct turn," and serves to prevent error in counting the number of turns and as a rough check on resultant angles.

By manipulating the front and rear leveling screws to bring the telescope to a level indication, and by sighting the target with use of vertical motion screws, as many "direct turns" may be made as the lengths of plate-leveling screw threads will permit. At the end of this series of direct turns the telescope will be pointed to the target. Read the vertical vernier and record the angle as "Direct 4, 6, 8, 10", as the case may be (ordinarily vertical angles will be such that ten turns can be made).

Make as many reverse turns as there are direct turns by bringing the telescope to level indications with use of vertical motion screws instead of plate leveling screws, and to sightings on the target with use of plate leveling screws instead of vertical motion screws. The telescope will be clamped at level indication at the end of this series of reverse turns. Record the vertical vernier reading as "Reverse", giving it the proper number.

The first set of readings is now complete. As in measuring precise horizontal angles, however, another set is taken. This completes the field work.

Reduction of notes is simple

Reduction of the vertical angle observation is simple. For each set, the D-O and the last of the reverse readings are averaged and this value is subtracted algebraically from the last

of the direct readings. In each case the result is the average cumulative angle for the number of turns made in that set.

The final answer is found by averaging this value from the first and second sets and dividing by the number of turns in each set.

In all but exceptional cases the stations sighted will later be occupied and reciprocal observations should be made so that true differences in elevations may be determined. This can be done by averaging each two apparent differences in elevation without dependence on instrument error and curvature plus refraction.

After two or more pairs of stations have been observed by the reciprocal method, an exact determination of the instrument error and the "earth curvature plus refraction" should be calculated. For more accurate determination of these factors, one pair of stations should be not far apart (preferably about two miles) and the other pair a distance of about three or four miles apart. Comparison of apparent differences in elevation with true differences in elevation determined by the reciprocal observations will show how the instrument error and earth-curvature-plus-refraction factors can be determined.

Small angle reduces distance error

Such determinations should be made using different groups of stations until the average will be within the accuracy desired. After this has been done accurate differences in elevation may be determined for those stations between which reciprocal observations were impracticable.

Each instrument used in an extensive survey should have its correction factors recorded, and should be continuously checked to guard against any change in instrument error. It is not intended to enter into the mathematics of how these factors may be determined except to state that it may be assumed that instrument error increases as the distance and earth curvature plus refraction increases as the square of the distance between stations.

In cases where the angular difference in elevation between two stations is greater than desirable the distance may be redetermined to an appropriate degree of accuracy. It is preferable, however, for the instrumentman to offset, whenever practicable to do so, to an elevation that would reduce the size of vertical angle and minimize the effect of distance error.

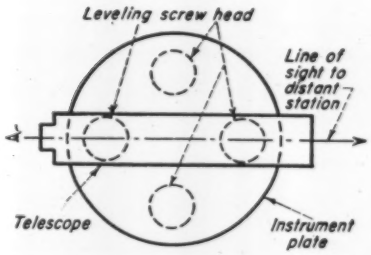


Fig. 1. Precise measurement of vertical angles with ordinary transit requires that line of sight be fairly close to alignment with one pair of leveling screws.

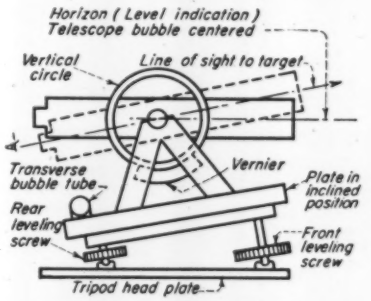


Fig. 2. Greater precision in observation of vertical angles is gained by using transits' plate-leveling screws as second vertical motion for angle measurement by repetition.

As angles become very great the number of turns which can be used within the range of the plate leveling screws is diminished rapidly. An angle of 10 deg. would probably require constant adjustment of one leg of the tripod to make four turns direct and four reverse.

As the method described was devised for long-range leveling by vertical angles, possibilities of turning large vertical angles need not be explored. Although it is apparent that its greatest usefulness would likely be in extensive triangulation networks, the method has been used on long range determinations for pier bridge seats and has shown benefits in most surveys, rough or precise, because of its accuracy and savings in time and labor.

SAMPLE FIELD RECORD OF VERTICAL ANGLE OBSERVATION

Inst. at—*Butte* Sighting at—*Pinnacle*
H.I. *4.76* *White flag 10.38 high*

1st Set		2nd Set	
Reading	Angle	Reading	Angle
D.—0	−6° 15′	D.—0	−5° 58′
*D.—1	−5° 01′	*D.—1	−4° 45′
D.—10	+6° 06′	D.—10	+6° 21′
R.—10	−6° 14′	R.—10	−5° 59′

* This reading is taken to prevent error in counting number of turns and for a rough check on resultant verticle angle.

Adopt New Parking Plan For Miami Beach, Fla.

Under a new 4-point parking program adopted recently by Miami Beach, Fla., municipal parking stations served by bonded attendants will be established on main business streets the International City Manager's Association reports.

The program was adopted to provide adequate parking space in all commercial and multiple-family areas in Miami Beach.

Miami Beach's parking problem increases due to the tremendous rise in population during the winter months. The city has 22,000 hotel rooms and 10,000 apartment units, largely occupied by people who arrive by automobile. More than 100,000 cars enter and leave the city each day.

The four points of the proposed parking program are:

1. The city will utilize municipal property close to the business district. On the municipal golf course provision is being made for parking 400 cars; this project will be extended to accommodate 1,000 cars. Other tracts owned by the city will accommodate about 900 cars.

2. The city will purchase off-street parking areas where city-owned property is not now available, if a proposed bond issue is approved.

3. Parking stations will be established two blocks apart, and closer in more crowded areas. Drivers can call for their cars at any one of the stations. A nominal charge will be made for the special parking service. It is expected that street parking may be eliminated in locations where this plan is in operation.

4. Parking meters will be installed on business streets near the ocean and on other business streets where off-street parking has been or will be provided, and in off-street parking areas. The meters will be installed only for the purpose of regulating traffic and making possible the efficient use of parking space.

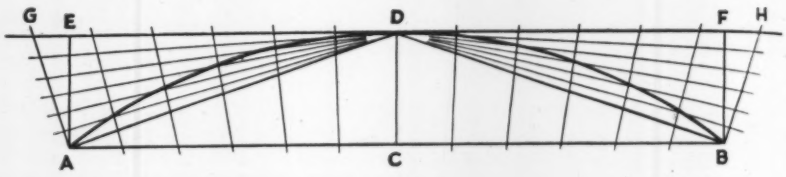
From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Rapid Method for Laying Out Templates for Metal Shapes

A simple, speedy and accurate method of constructing the arc of a segment of a circle when the length of a chord and height of the middle ordinate are known is illustrated in the accompanying figure. The procedure is useful in laying out templates for shapes on metal work.

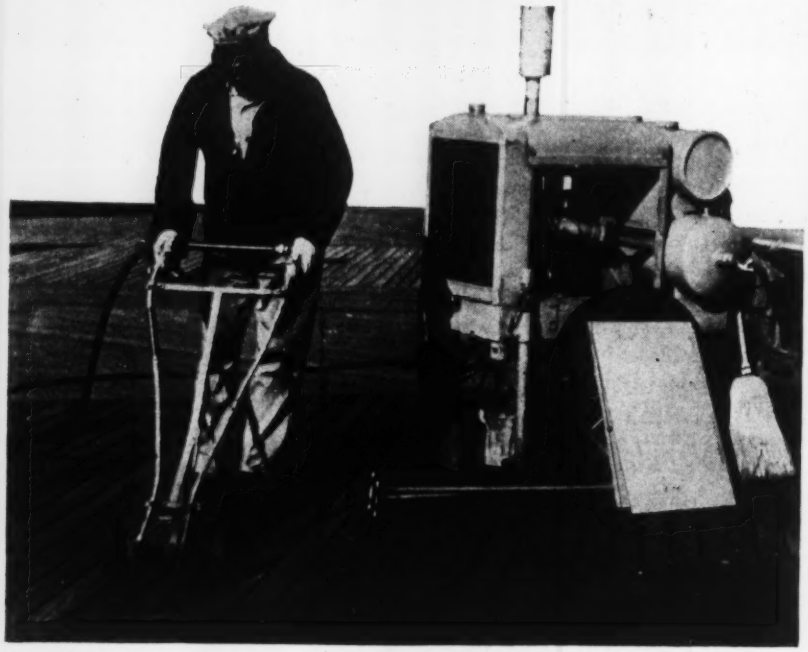
With chord AB and middle ordinate CD given, draw GH through D parallel to AB. Draw AD and BD. AG is drawn perpendicular to AD, BH perpendicular to BD and AE and BF perpendicular to AC through points A and B, respectively. Divide AB and GH into any number of equal parts and AE and BF into one-half the number of equal parts as used to divide the lines AB or GH.



Circular curve laid out by geometric construction when length of chord and middle ordinate are given.

Draw lines from point D through division points on AE and BF, respectively. Also, draw lines through division points on AB and GH. Then plot segment of circle at intersection of points as shown on the drawing. B. A. BATES, Engineer, *Development Dept. Central of Georgia Railway Co.*

COMPRESSED-AIR JETS CLEAN BOARDWALK CRACKS



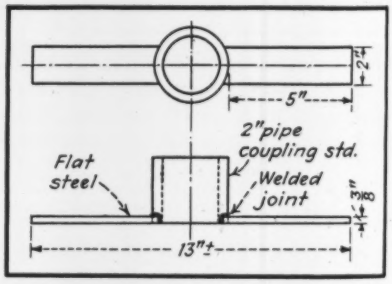
Because dirt and debris accumulating in drainage cracks between planks of its famous 8-mi. long boardwalk causes deterioration of the stringers, the Atlantic City, N. J., Department of Public Works has developed a special method for cleaning the cracks.

The procedure adopted is one that literally "blows away" the accumulated debris. As shown above, a specially built light-steel frame supports dual air-jets adjusted to fit the width of the deck planking. Each jet is controlled by means of a hand-operated self-closing air valve mounted at the handgrip of the frame. Pneumatic-tired 4-in. wheels make for ease in shifting the blower as cleaning proceeds. Air for the jets is supplied by a small mobile compressor unit. The operation is characterized as being rapid, effective and economical by William F. Casey, commissioner of public works at Atlantic City.

Safety Guide Aids Air Drill Work

Where much drilling of concrete pavement or flooring is necessary, the guide shown in the accompanying drawing will safeguard drill operators from accidents due to slipping of a bull point or air hammer when held between the feet. The device, designed by A. W. Clough, superintendent of distribution for the Malden & Melrose (Mass.) Gas Light Co., consists of a 2-in. standard pipe coupling 2-in. high, to which are welded two flat steel bars. Each of the bars is about 5 in. long, 2 in. wide and $\frac{3}{8}$ in. thick. All edges of the bars are filed smooth.

When drilling, the operator's feet are placed on the steel bar at each side of the coupling, which holds the drill steady. The assembly weighs $6\frac{1}{4}$ lb.



Protective device for use in drilling floor or pavement is easily made by welding strap iron to standard 2-in. coupling.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Chimneys and Atom Bombs

Sir: In *ENR* for Dec. 20, 1945, p. 5, you discuss the survival of circular brick chimneys at Nagasaki, stating "cylindrical shapes seemed to deflect the concussion wave because of their curved surfaces." Undoubtedly, there are surface reflections, but the following explanation appears to the writer to be a more reasonable hypothesis.

A superheated concussion wave travels at a speed greater than the normal speed of sound, initially creating high pressures on all outside surfaces of closed structures. In a few thousandths of a second the zone of high pressure touches the near side of the chimney, envelopes the whole chimney in high pressure, and passes beyond. The chimney survives primarily because of two reasons:

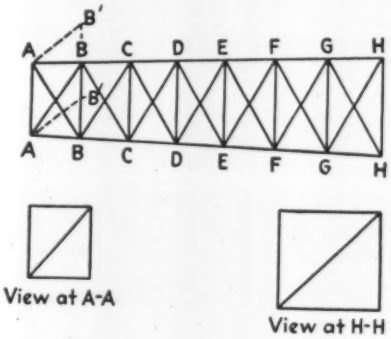
(1) The natural period of vibration of the chimney is large compared with the total time required for the pressure to build up all around the chimney, hence the net lateral or toppling effect is small. A flexible structure with a large natural vibration period is but little affected by sudden blows of short duration.

(2) As soon as the chimney is completely surrounded by nearly equal high pressure it is a structure well-designed to withstand such loads, entirely in compression, being a complete arch ring. Furthermore, it is a heat-resistant structure.

BRUCE G. JOHNSTON
Associate Director
Fritz Engineering Laboratory

Bracing in Towers

Sir: The letter of Edward Godfrey (*ENR* Sept. 20, 1945, vol. p. 358) contains several errors. If section BB in the diagram below were to take the shape he suggests, it would mean that points BB on one side of the tower would have to move to the positions indicated by B′ B′. Similar points on the far side of the tower would move in the opposite direction. However, movement of this nature is prevented by the vertical diagonal bracing. It will thus



be seen that, provided the ends of a section of a tower have horizontal diagonal bracing, there is no possibility of any intermediate horizontal section becoming distorted.

Further, the strength of the individual corner posts is not dependent on the height of the tower, but upon the spacing of the horizontal braces.

A. M. SCARLETT
Draftsman
Public Works Dept.
Auckland, New Zealand

Seabee Project Management

Sir: As an officer in one of the Naval Construction Battalions on Tinian I have read with interest the article by Commodore Halloran, "Building B-29 Bases on Tinian" (*ENR* Sept. 6, 1945, vol. p. 302). I would like to compare the "lead battalion" system as there described with the system used on a multi-battalion airfield project on Adak, Alaska. Both projects (Tinian and Adak) were completed on time despite the opinion of experienced construction engineers that this would be impossible.

The work on the Andrews Lagoon, Adak, project under the direction of Capt. (then Comdr.) L. A. Cline, CEC, USNR, was organized on a battalion basis. Each battalion was assigned a definite part of the construction and had complete control of its section under the general supervision of the regimental staff. Engineering was done by a central organization.

An advantage of such battalion autonomy is that battalion officers work their own men and equipment and are in control of their portion of the job at all times. Under the lead battalion system, on the other hand, officers in charge on the field do not know the men and instructions are not as effectively carried out.

Another advantage of the battalion basis is that it encourages a keen spirit of competition. Men from one battalion can see how the work of their unit compares with that of other units.

Under the system used at Adak all personnel were employed to greatest advantage. Under the Tinian system key jobs were taken by personnel of the lead battalion while personnel of other battalions assigned to the job played a minor role.

It may be necessary in some cases to use something like the "lead battalion" system. However, it is the opinion of the writer that battalion autonomy is a much better way to accomplish the same purpose.

A SEABEE OFFICER

Raising Water Tanks

Sir: The article describing raising of elevated steel water tanks (*ENR* Jan. 17, vol. p. 89) is of particular interest to me. Some years ago our firm had a problem of raising a 200,000 gal. tank 35 ft. vertically at Pasco, Washington. We consulted various tank companies and their proposal was to dismantle the tank and tower and re-erect it with longer legs. This did not seem efficient or necessary so we called for bids on the work, suggesting certain methods, but giving bidders wide latitude as long as they secured the desired results. The Steel Construction Co. of Portland, Oregon, made a reasonable bid and carried the work through successfully.

This was a six leg tank, about 85 ft. high to water level. The contractor erected gin poles, each made up from two 50 ft. telephone poles, at three alternate legs. Adequate tackle was provided and hooked onto the bottom of the legs with a separate gasoline hoist provided for power at each leg. The tank was guyed in all directions and men were stationed at the various guys to slack them off as the tank was raised. When everything was ready the nuts were taken off the anchor bolts and the lifting of the tank to the specified elevation required only 1½ hr. New legs and new cross bracing were installed

and bolted up. The entire job of raising and supporting the tank took less time than rigging and getting ready for the lift.

Calculations showed that existing footings were reasonably adequate for wind stresses. The new legs inserted under the old are vertical. This gives the tank a rather odd "dog leg" appearance but it serves its purpose.

The bid price for this raising operation was about $7,000 and I am sure that the contractor made a very handsome profit for the risks that he took. I will guess that the costs were very much less than those for the smaller tanks described in the recent article.

JOHN W. CUNNINGHAM
Consulting Engineer
Portland, Ore.

Spillway Energy Dissipation

Sir: I have read with great interest the article, "Energy Dissipation at Fontana Spillway" (*ENR* Nov. 29, 1945, vol. p. 86) and your editorial comment on this method for dissipating hydraulic energy.

A similar problem on a smaller scale, which was solved by similar means, was encountered in 1939, during the design of the Arkport Dam by the Binghamton, now the Syracuse District of the Corps of Engineers. This dam, a rolled earth embankment, about 110 ft. high and located on the Canisteo River, about five miles upstream from Hornell, N. Y. forms a part of the work for flood protection at Hornell. A side channel spillway designed for 29,000 cfs. and an 8-ft. diameter tunnel, reduced at the lower end to a 4-ft. 4-in. diameter bore by a cast iron nozzle to limit maximum discharges to 1,000 cfs., both discharge into a common outlet structure in the right abutment. Due to the close proximity of the outlet structure to the toe of the earth embankment, it was necessary to prevent dangerous scour. As a stilling basin was found to be too expensive on account of low tailwater, a flip bucket shown in the accompanying drawing, which will direct and spread the falling sheet of water in such a manner that the resulting scour will not endanger the safety of the dam, was developed by hydraulic model tests at the district foundation laboratory at Ithaca, N. Y.

Since storage in this reservoir is entirely reserved for flood control, there has been no opportunity to test the performance of the bucket for spillway flows. However, the action of the flip bucket during high conduit discharges, up to about 800 cfs., which have occurred about twice each year since completion of the dam in 1940, showed closed agreement with the model tests.

Design and construction of the Arkport Dam was under the direction of Brig. Gen. G. J. Nold, district engineer of the former Binghamton District; the Syracuse District which operates the completed reservoir is headed by Col. J. S. Seybold. The writer was in direct charge of this design.

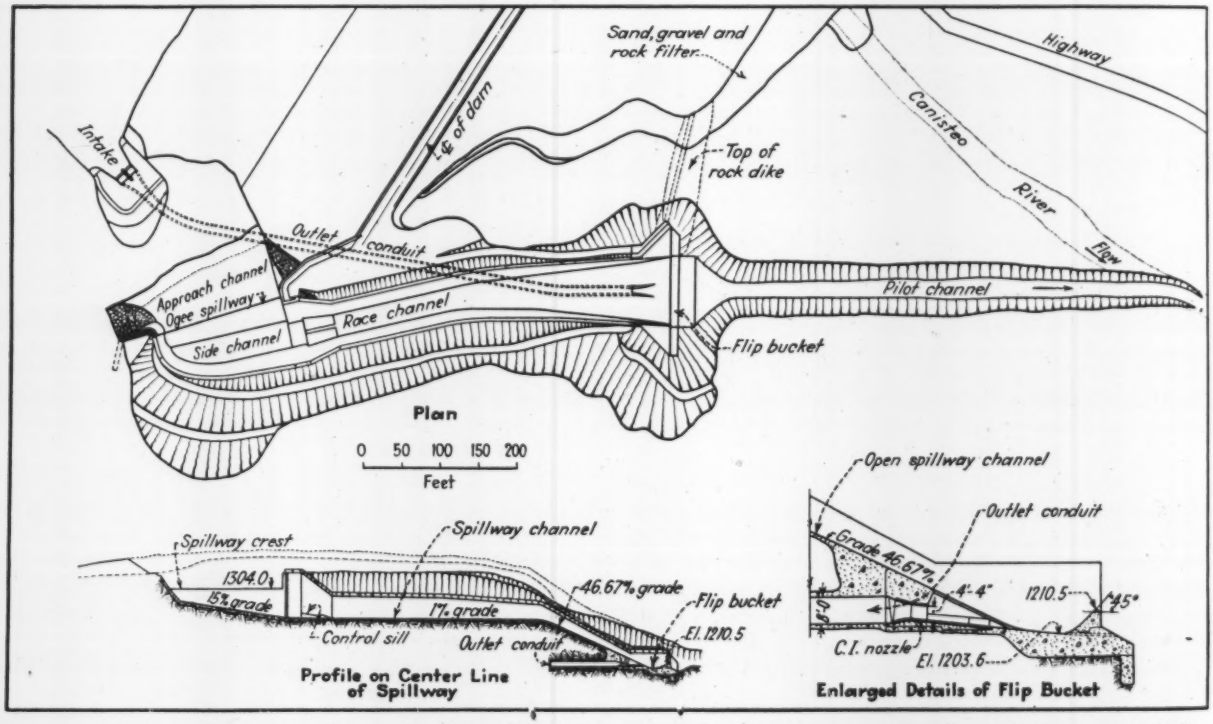
E. M. GRAF,
Senior Engineer
Syracuse District
U. S. Engineer Office

Airbase Identification

Sir: In the Sept. 27 issue of *Engineering News-Record*, p. 14, I note some misinformation in connection with the picture of the U. S. Naval airbase at Marpi Point on Saipan. Marpi Point is 4,200 ft. long, not 8,500, as stated in your article. Also, the strip is coral surfaced and not black-topped.

Although there is another airfield on Saipan that meets your description—the twin B-29 strip, Isley Field—the airfield in the picture is definitely Naval airbase Marpi Point.

J. ROY PENNELL, JR.
Ensign, CEC, USNR
Island Command
Saipan Marianas



Spillway at Arkport Dam where the energy of the discharged water is destroyed by means of a flip bucket of unusual design.

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

Wartime Roadbuilding

THE BUILDING OF THE BURMA ROAD—By Tan Pei-Ying, 200 pp. Whittlesey House, New York 18, N. Y. $2.75.

Admirably blending factual and technical details with local color and historical perspective, the author presents a stirring testimonial to the indomitable courage, patience and skill of the Chinese builders of the famed Burma Road. With never enough men or money and with almost no modern equipment, a large part of the construction was carried on by hand labor recruited from the surrounding country. For the many miles of hard rock cutting necessary in some of the world's most rugged terrain, the only blasting powder available was Chinese gunpowder of the kind used for firecrackers.

Simply but vividly told in a manner that will appeal to the general public as well as the engineer, the story of the road is carried through the long laborious months from the start of construction to the retreat of the Chinese armies from Burma in 1942, when it became necessary to dynamite the Salween River bridge to cut off the Japanese advance.

A Contractor's Recollections

BRAWN AND BRAINS: The Adventures of an International Contractor—By Franklin Remington. 217 pp. Bruce Humphries, Inc., Boston. $2.75.

Books on the career lives of prominent engineer builders are so rare that the reader hastens to open the volume when one appears. As the head for twenty years of the Foundation Company, and as an active contractor for twice that time, the author of "Brawn and Brains" lived and worked through a period great in construction history. That he has not given more of his observation concerning the period and of the part that his company took in the technical developments of the period is disappointing. His book is more an account of activities of personal interest to family and friends. This the author gives in a pleasingly chatty style beginning with his preparatory school days, his college years at Harvard and a year of adventurous travel. Then in chapters on First Steps in Business, Thrills and Ills of Engineering-Contracting, The Turkish Concession, Complications in Rome, Contracting in the Balkans and Some Notes on the Latin Races he tells of politics and politicians and government practices met with and evaded in negotiating contracts and concessions in eastern and southern Europe. Taken for what it is, a series of sketchy reminiscences, Mr. Remington tells an interesting story.—*Reviewed by* C. S. HILL, *Long Branch, N. J.*

Valuable Bridges Data

SEMIPERMANENT HIGHWAY AND RAILWAY TRESTLE BRIDGES—U. S. War Department Technical Manual TM5-286. 350 pp. Superintendent of Documents, Washington 25, D. C. $1.75.

Engineers engaged in designing, erecting and maintaining highway and railway bridges, bridge constructors and structural engineering students will find much of interest in this manual. Although prepared specifically as a guide to the wartime erection of trestle bridges, it contains a vast amount of technical information which will find widespread usage in peacetime bridge construction.

In general, the manual covers procedures for selecting location, type and length of structural steel and timber spans, and type and height of supporting trestle work. It explains methods of fabricating structural steel, of framing timber, and of erecting trestle bridges made of these materials. Of special interest is the description of special tools and construction equipment used in the work.

At first glance, the reader will be intrigued by the dozens of perspective drawings covering the several phases of trestle bridge construction. Hundreds of other drawings and photographs sprinkled throughout the text of the manual portray modern methods for meeting such problems as substructure exploration of bridge sites by sounding rod or wash-borings, and how to make load tests in determining the bearing capacity of solids. One chapter, devoted to field repair of bridges, will be of unusual interest to the bridge maintenance engineer. It describes the straightening of bent structural steel beams, flame cutting and welding of steel members, and gives practical tips on field riveting.

Pile driving methods are fully explained and illustrated, and several practical suggestions are given for bracing, splicing, straightening and pulling piling.

Of unusual interest are cut-away perspective drawings showing the structural bracing of sheetpile and timber cofferdams, both rectangular and cellular. Shown in table form are properties of timber structural members, wire and manila rope, chains, safe loads on hooks, safe sling loads and the load capacities of various block-and-tackle arrangements. Lifting capacities of a dozen or so commercial crawler and truck-mounted cranes, together with other data on draglines, clamshells, pile drivers and power shovels also are shown in convenient table form.

Actual designs of superstructures and substructures contained in the manual will not be of much value to the highway bridge designer, as they necessarily were made for live loads involving tanks and other heavy fighting equipment. Railway trestles, however, were designed for Cooper's E-45 live loading.

The manual was prepared as a wartime project by Howard, Needles, Tammen and Bergendoff, consulting engineers, Kansas City, Mo.

Engineering Mechanics

MECHANICS FOR ENGINEERS—By Edward R. Maurer, Raymond J. Roark and George W. Washa. 425 pp. John Wiley & Sons, New York; Chapman & Hall, London. $4.

"Technical Mechanics," which was published originally in 1903 and revised in 1914 and in 1925, has now been rewritten again. In this last revision, the text book has been so changed and amplified that the adoption of a new and more accurate title seemed advisable.

More attention is given in this revised text to problems in statics that involve non-coplanar forces, and kine-

matics and kinetics are treated concurrently instead of separately. While plane motion and relative motion are dealt with more extensively, d'Alembert's principle receives greater emphasis in view of the increasing importance of such subjects as engine balancing and dynamic stress. Topics that have been added are virtual work and mechanical vibrations.

Industrial Water Treatment

BETZ HANDBOOK OF INDUSTRIAL WATER CONDITIONING—W. H. & L. D. Betz, Chemical Engineers, Gillingham and Worth St., Philadelphia 24, Pa. 171 pp., $1.

An easily understandable text for study or reference, the book is divided into two parts—water treatment and water analysis. In the first section are discussed chemical and mechanical processes available for the treatment of water for industrial use, covering such subjects as coagulation, filtration, lime-soda softening, anion exchange, silica removal, boiler scale formation, embrittlement, and slime and algae control. Coverage of chemical treatments for cooling water and boiler-feed water might be more complete in that attention might have been directed to some of the modern organic chemicals. Impurities in water—how they originate, methods of removal and analytical procedures for plant control—are skillfully dealt with in the second section. Possibly the handbook would be easier to use if an index were provided.

Applied Hydraulics

A TREATISE ON APPLIED HYDRAULICS—Third Edition. By Herbert Addison. 614 pp. John Wiley & Sons, New York 16; Chapman & Hall, London. $6.50.

Considerably enlarged, this third edition gives particular attention to new developments in the fields of frictional loss in closed and open conduits, pressure and thrust on immersed solids, water hammer in pipes and pressure distribution on pump and turbine blades. The latter subject is treated with relation to its effect on cavitation and suction lift.

The new material gives the book greater clarity and practical utility, as it explains and interpolates many unduly compressed passages of previous editions. In addition, the number and variety of illustrative examples have been substantially enlarged, and the bibliography made much more comprehensive and up-to-date.

Miscellaneous Notes on Booklets and Reprints

TESTS ON SIXTY PRIMING COATS for steel are reported in "Building Materials and Structures Report BMS102" entitled "Painting Steel" issued by the National Bureau of Standards (Superintendent of Documents, Washington 25, D. C., price 10c.). This is the third and final report on a study made at the bureau covering pre-treatment and paints for protecting plain and galvanized steel surfaces from corrosion.

MEN IN THE CONSTRUCTION FIELD who are interested in helping veterans get reestablished in a peacetime occupation will find much helpful information about their own industry in "Opportunities Unlimited—A Guide for Veterans Interested in the Construction Industry". Copies can be obtained at 10 cents each from E. L. Chandler, Room 703, 1026 17th St., Washington 6, D. C. The pamphlet was prepared by the Committee on Opportunities for Veterans in the Construction Industry, which was set up last fall by the principal organizations in the civil engineering, architectural and construction fields.

RECENT BULLETINS of the American Public Works Association cover the following subjects: Bulletin No. 25, Current and Suggested Street Cleaning and Maintenance Practices in American Cities (75c.); Bulletin 26, The Dynamics of Street Layout and Design for Urban Traffic ($1); Bulletin 27, Airports—Location, Design, Financing, Zoning and Control ($1); and Bulletin 28, A Transportation Symposium—Waterways, Airways, Railways and Highways ($1). These bulletins can be obtained from the American Public Works Association, 1313 E. 60th St., Chicago 37, for the prices indicated.

THE SWEDISH CEMENT AND CONCRETE RESEARCH INSTITUTE, which was inaugurated in May, 1945, has issued five bulletins covering research work, some of which was inaugurated as early as July 1942. Three of these are available in the English language from the institute at the Royal Technical University, Stockholm, Sweden. They are: No. 3, Chemical Processes in the Hardening of Portland Cement; No. 4, The Modulus of Elasticity of Concrete; and No. 5, Wear Resistance Tests on Concrete Floors and Methods of Dust Prevention. The two that are not in English relate to the organization and work of the institute and its buildings.

New Engineering Books

PAINT MANUAL—With Particular Reference to Federal Specifications—By Percy H. Walker and Eugene F. Hickson, National Bureau of Standards. 165 pp. Superintendent of Documents, Washington 25, D. C. $1.

WATER SUPPLY AND PURIFICATION—By W. A. Hardenbergh. Second Edition. 488 pp. International Textbook Co., Scranton, Pa. $4.

ARCH DESIGN SIMPLIFIED—By W. A. Fairhurst. 61 pp. Concrete Publications Ltd., Westminster, S. W. 1 England. 12 shillings.

ENDLESS HORIZONS—By Vannevar Bush. 182 pp. Public Affairs Press, Washington 8, D. C. $2.50.

ELEMENTARY MECHANICS OF FLUIDS—By Hunter Rouse. 376 pp. John Wiley & Sons, N. Y. $4.

YOU AND THE UNIVERSE—By John J. O'Neill. 328 pp. Ives Washburn, Inc., New York 19, N. Y. $3.50.

PROCEEDINGS OF THE INDIA ROADS CONGRESS, January 1941—Volume VII, Part I (in two sections). Published by the India Roads Congress, New Delhi, India. 10 shillings.

NEW CITIES FOR OLD—Louis Justement. 232 pp. McGraw-Hill Book Co., New York 18, N. Y. $4.50.

THE ROLE OF TRANSPORTATION IN THE DEVELOPMENT OF VERMONT—William J. Wilgus. 104 pp. Vermont Historical Society, Montpelier, Vt. $3.

Reports and Pamphlets

BEWASSERUNGS-ANLAGEN, No. 1. Beobachtungen und Erfahrungen biem Bau in sudlichen Landern.—By H. E. Gruner. 58 pp. Leeman & Co., Zurich, Switzerland. 9 Francs.

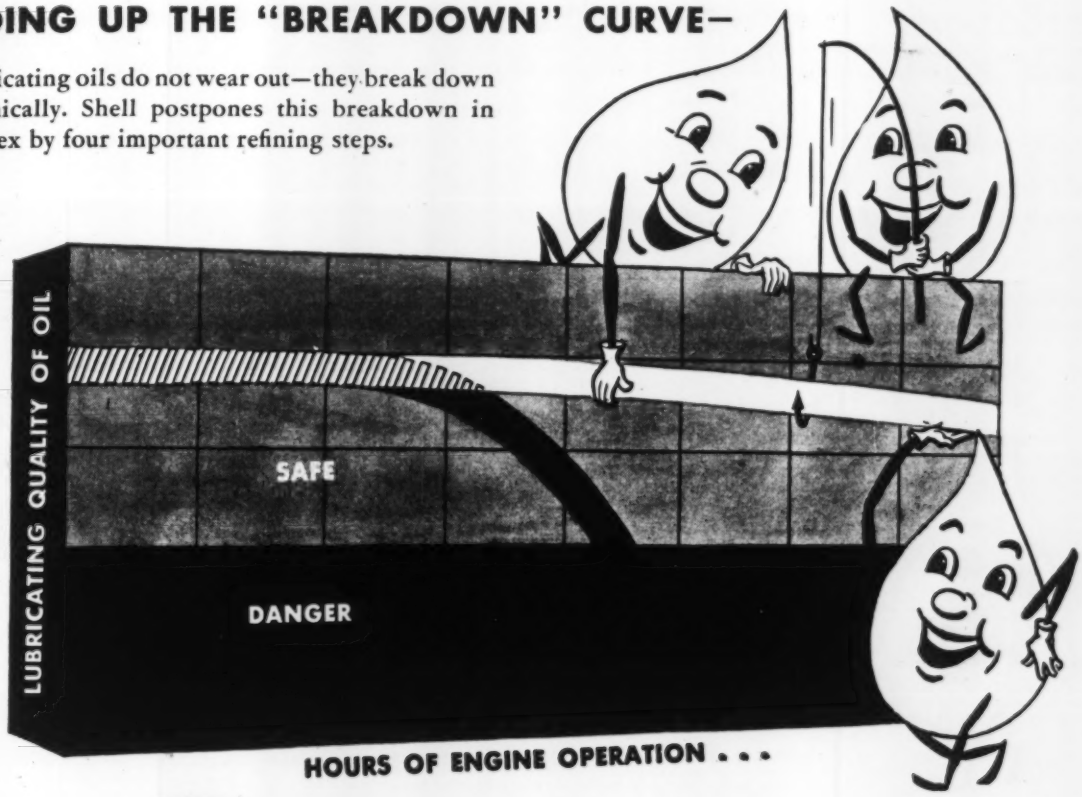
PUENTES DE ARCO DE HORMIGON ARMADO, Formulario Para Proyectos—By C. F. Casado. Published by Dossat, S. A., Madrid, Spain.

PUENTES DE TRAMO RECTO: Coleccion Oficial, Ministerio de Obras Publicas, Madrid, Spain.

(*Continued on p. 126*)

HOLDING UP THE "BREAKDOWN" CURVE—

Lubricating oils do not wear out—they break down chemically. Shell postpones this breakdown in Talpex by four important refining steps.



THESE 4 TALPEX PERFORMANCE FACTORS SAFEGUARD HIGH-SPEED DIESELS

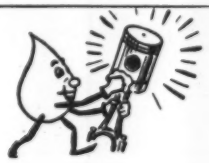
1.

Talpex is protected by the removal of the oil's natural liabilities—those oil components that readily oxidize. Shell does this by means of a special solvent-extraction process.

2.

Talpex is protected with an anti-oxidant that effectively serves to still further retard the formation of corrosive compounds and objectionable sludge and lacquer.

3.



Talpex has effective corrosion-preventive properties which are obtained by special refining methods. This means better performance and longer life of the engine's wearing parts.

4.

Talpex has detergent properties that keep carbon, lacquer and rust particles from adhering to pistons, rings, valves and ports—keeps these contaminants "moving" until drained from the engine.

The Shell Lubrication Engineer will give you sound advice about the lubrication of *any* type of Diesel, whether slow, medium, or high-speed. Write for a copy of Shell's booklet, "The Fundamentals of Diesel Lubrication." Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York or 100 Bush Street, San Francisco 6, California.

SHELL

SHELL DIESEL LUBRICANTS

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

CONSTRUCTION MATERIAL and labor rates in March as reported to *Engineering News-Record* reveal several changes from the preceding month. Effective February 20, 1946 the OPA authorized a uniform increase of $3.25 per M board feet for all housing construction items manufactured from Southern pine lumber except flooring, which has increased $5.00 per M, and lath which was not increased in price. No increases were granted in Southern pine car material, stress grades, structural joists and planks and timbers larger than 8 x 8 in. Former price increases in Southern pine lumber is reflected by ENR cities Baltimore and Birmingham: Baltimore, upped the lumber price $4.00 per M and Birmingham $5.00 this month. ENR reports no change in carbon and alloy steel products this month, but an increase on an average of $5.00 per ton is anticipated March 2, 1946 and will be retroactive to Feb. 15, 1946. Lumber remains very scarce in ENR cities with applications for price increases submitted in most. In Detroit this month expanded metal lath (std. diamond mesh, 3.4 lbs. per sq. yd.) is quoted at $25.00 whereas in February it was $30.00; this is not a price drop but a change in method of quoting. Several cities reported wage increases for both skilled and common labor. In Baltimore bricklayers went from $1.75 to $1.90; hoisting engineers from $1.625/1.80 to 1.625/2.00. In Detroit, bricklayers rose from $1.725 to $1.90; carpenters from $1.50 to $1.625, and common labor from $1.00 to $1.15. In Los Angeles all, ENR skilled and common wages increased 12¢ to 25¢.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F. O. B. CITY

	PORTLAND CEMENT — Per bbl., C/L lots, incl. 40c. per bbl. for bags, cash dis. not deducted			SAND AND GRAVEL — Per ton, carload lots			CRUSHED STONE — Per ton, carload lots		CRUSHED SLAG — Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK — 8x8x16-in.; truckload del.; per block		READY MIXED CONCRETE — truckload 1:2:4, over 50 c.y., del.
	Cloth *a*	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand-grav.	Lt.wgt. Agg.	
Atlanta	$2.77	$2.52	$2.43	$1.79	$1.89	$1.65	$1.79	$1.89	$1.59	$1.69	$0.17	.....	$8.30
Baltimore	2.62	2.37	2.12	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.75‡	1.75‡	.125	$0.125*w*	7.45
Birmingham	2.50	2.25	2.10	1.75	1.75	1.50	.85	1.00	.90	1.15	.1425	....	5.95
Boston	2.79*b*	2.72*b*	2.52*	1.50‡	1.50‡	1.05‡	1.25‡	1.35‡	....	....	.13	.155*w*	7.55*m*
Chicago	2.90	2.65	2.50	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	1.75‡	1.75‡	.18	.18*x*	....
Cincinnati	2.51	2.26	2.06	1.20	1.20	1.10	1.80	1.80	....	....	.13	.17*w*	6.85
Cleveland	2.59	2.34	2.19	1.75*i*	1.75*i*	1.25/1.65*i*	1.80*i*	1.80*i*	1.15	1.15	.14	.14	8.15
Dallas	2.51	2.26	2.06	1.50*p*	1.70*p*	1.10*p*	1.69*p*	1.79*p*	....	....	.15	....	7.15
Denver	3.32	2.72	2.47	1.20	1.25	.90	1.65	1.75	1.00	1.00	....	.15	9.10
Detroit	2.59	2.34	2.16	1.75	1.75	1.55	2.25	2.25	2.00‡	2.00‡	.14	.15*w*	7.15
Kansas City	2.78	2.57	2.38	1.85	2.30	1.00	1.91	1.91	....	....	.125	.125*wy*	7.50*n*
Los Angeles	3.00*v*	2.40*v*	....	1.30	1.30	1.15	1.30*f*	1.30*f*	....	....	.04*bb*	.075*aa*	7.25
Minneapolis	3.10	2.88	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	.14	....	7.85*j*
Montreal	....	1.95*r*	1.79*r*	1.65‡*s*	1.65‡*s*	1.50*t*	.80*ct*	.90*ct*	....	....	.1999	.17*wt*	9.20*ls*
New Orleans	2.41	2.16	1.92	1.67	1.65	1.22	....	....	.90	1.15	.19	....	9.25
New York	2.85‡	2.60‡	....	1.60*de*	1.60*de*	.90*de*	1.80*de*	1.80*de*	....	....	.16	.14*wcc*	8.25*k*
Philadelphia	2.73‡	2.48‡	2.28‡	1.55‡	1.65‡	1.20‡	1.90‡	1.95‡	1.10	1.10	.155	.155*w*	8.55
Pittsburgh	2.80	2.55	2.35	1.65‡	1.65‡	1.85‡	2.25‡	2.25‡	1.50	1.50	.17	.17*z*	8.55
St. Louis	3.08	2.80	....	1.75‡	1.75‡	1.65/1.75‡	1.25/2.00	1.25/2.00	.90*g*	1.15*g*	.155	.18*y*	8.60
San Francisco	2.21	2.01	1.71	1.36	1.36	1.36	1.46	1.46	....	....	....	.215*y*	7.55
Seattle	....	2.75*o*	....	2.35*d*‡	2.35*d*‡	2.35*d*‡	2.85‡*od*	2.85‡*od*	....	....	.16	....	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* Withdrawn. *v* 20c. per bbl. discount; 80c. per bbl. for bags. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 x 18 in

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.90	$1.85	Ironton, Ohio	$1.80*	$1.75*	Richard City, Tenn	$1.90	$1.85
Dallas, Tex	....	....	Limedale, Ind	....	....	Steelton, Minn	2.00	1.95
Hannibal, Mo	1.90	1.85	Norfolk, Va	....	....	Universal, Pa	1.85	1.80
Hudson, N Y	....	....	Northampton, Pa	1.75	1.70	Waco, Tex. (Plus 9c. tax in Tex.)	1.75	1.70
Independence, Kans	1.90	1.85	North Birmingham, Ala	....	....	Montreal City (Discount 10c. per bbl. 20 days)	1.68	1.67

* Destination price base; effective Sept. 17, 1945.

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

	PAVING BRICK AND BLOCK — Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	PAVING ASPHALT — Per ton, less than 80 penetration: Tank car	Drums	ASPHALT BINDERS—FLUXES — Per gal., 80–300 penetration: Tank car	Drums	CUTBACK ASPHALT — Per ton: Tank car	Drums	ROAD OIL — Per gal. Tank car	ASPHALT EMULSION (Quick-breaking) Per gal.: Tank car	Drums
Atlanta	$73.00	.....	$2.25	.....	$14.00	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0805	.....
Baltimore	150.00‡	49.00	85.00*m*	15.00*r*	21.00*r*	.06*r*	0.09*r*	13.00*r*	23.00*r*	.06*r*	.07*r*	.14*r*
Birmingham	150.00	32.00*j*	.....	17.95	.....†	.0747	.....†	.0834*h*	.....†	.065	.095	.....†
Boston	85.00	59.00	3.75	15.00	24.00	.0625	.115	17.00	30.00	.0625	.0825	.145
Chicago	150.00‡	60.00*e*‡	2.85/4.00*d*	14.00	22.50	13.00*g*	21.50*g*	.0575*h*	.15*h*	.05*n*	.09/.10*n*	.13/.15*n*
Cincinnati	120.00	55.75	.....	17.00	.....	.085	.....	12.25	.....	.07	.085	.....
Cleveland	120.00	34.00	3.74	17.00	19.00	.085	.095	.10*h*	.11	.08	.10	.....
Dallas	.....	36.00	.....	13.65	20.30	.06	.11	16.00	24.80	.06	.05/.07	.07/.09
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	37.00	.....	17.60*f*	26.56*f*	.0734	.128	.0718*h*	.119*h*	.067	.0974	.135
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	9.00*b*	23.00*b*	9.50*bg*	24.00*bg*	9.50*b*	.....	.025*b*	.072*b*	.15*b*
Minneapolis	.....	.....	2.017*d*	.....	27.70	.....	.126	.....	32.64	.....	.....	.....
Montreal	70.00	.....	.....	16.60*k*	24.25*k*	.1035*k*	.111*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	.....	.....	.....	13.50*a*	20.00*a*	.057	.088	.06*h*	.095*h*	.....	.080	.....
New York	.....	65.00	.....	17.40	24.20	14.00	.....	.0725*h*	.1325*h*	.....	.0700	.119
Philadelphia	150.00	62.00	4.06	15.00	.....	14.00/15.00	.....	.0625*h*	.....	.....	14.00*gr*	.....
Pittsburgh	135.00	39.75	3.75	18.00	23.00	.09	.16	20.00	36.00	.07	.08	.13
St. Louis	.....	40.00	.....	14.80	19.80	13.80*g*	18.80*g*	.0587*h*	.1362*h*	.483	.07	.1215
San Francisco	.....	45.00	.....	10.90	20.15	10.90*g*	.....	12.90	.....	.....	.0525	.1125
Seattle	.....	.....	.....	10.90*i*	21.90*i*	.....	20.40*gi*	11.40*i*	13.90	10.90	.0525*i*	.0625*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 3½ x 4 x 8½ in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½ in. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3 x 3½ x 8½ in. *k* Tax included. *l* F.o.b. Toledo. *m* Per thousand. † Available in drums—quoted on request only. *r* February 1943 prices, none later available.

Two-way traction tire has new kind of bruise-resisting construction

Rock and dirt hauling, especially in wet weather, used to cause a lot of tire headaches. Heavy loads strained the tire body. Severe grades increased traction and slippage problems. Rocky terrain made tire life worse—for when tires hit rocks, ruts, etc., under load, the walloping blows led to bruises, ply separation, and blow-outs. Costly delays and repairs resulted.

B. F. Goodrich engineers took over the headaches. They designed a new tread with thick, heavy lugs—but designed it so that the natural running action pushed mud and dirt toward the edges. The tire stayed clean. It gave excellent traction and protection against side slippage. And—it gave equal traction in *either* direction.

Then the engineers developed an entirely new construction principle—the *shock shield*. This shock shield is a set of four breakers—layers of rubber-coated rayon cords—built in between the tread and the plies. These breakers are in pairs, with the cords in each pair running parallel to each other—but with each pair running in opposite directions to give balanced strength. The breakers are cushioned with thick layers of special shock-resistant rubber.

Under impact, the cords in the breakers stretch together, *not* across each other, and return to their original position. The blow is *distributed* and *absorbed* by the rubber cushions; the shock passed on to the cord body is greatly reduced.

This tire is called The Universal (shown above on truck in foreground). Users report fewer bruises, lower repair bills, longer wear, and that more tires can be retreaded. One operator's records show an average of over 4000 hours from B. F. Goodrich tires built this new way, compared to 1600 hours from another make. Others report similar savings.

You can save with B. F. Goodrich off-the-road tires—tires built to meet *your* needs. Find out more about them. See the B. F. Goodrich dealer, or write us direct. *The B. F. Goodrich Company, Akron, Ohio.*

Truck Tires BY

B.F. Goodrich

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¾-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.15	$3.75	$2.90	....	$43.00	$45.00	$45.00	$2.70	$3.00	$2.15	$4.75
Chicago	2.10	2.15	3.75	2.90	$2.40	43.00	45.00	45.00*	2.70	3.25	....	4.75
Pittsburgh	2.10	2.15	3.75	2.90	2.40	43.00	45.00	45.00*	2.70	3.25	2.30	4.75
Buffalo	2.10	2.15	....	....	2.40	.....	.....	.....	....	....	2.30	....
Cleveland	2.10	2.15	3.75	2.90	....	.....	.....	.....	....	....	....	....
Youngstown	....	2.15	....	....	....	.....	.....	.....	....	3.25	....	....
Detroit	....	2.27‡	....	....	....	.....	.....	.....	....	....	....	....
Gulf ports	2.47*a*	2.52*a*	....	....	2.85*a*	.....	.....	.....	....	....	....	....
Pacific ports	2.75*a*	2.80*a*	....	3.40	2.95*a*	.....	.....	.....	....	....	....	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per cl. * Per net ton.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS* Per 100 lb., ¾ in., base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires *k* Per 100 s. f.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.40	$2.40	$.02½	$.10	$21.06	$23.00	$1.82	$1.35	$1.91	$3.04
Baltimore	3.70	2.90	2.75	....	.10	23.00	25.00	1.70	1.27	1.79	3.00
Birmingham	2.10*a*	2.15	2.15	.02½	.10	19.00	21.00	1.80	1.34	1.89	....
Boston	3.912	3.994	....	$20 C.L.	.10	18.50	29.50	1.76	1.31	1.84	2.77
Chicago	2.10*a*	2.15*a*	2.15*a*	.03	.05	21.50‡	23.50	1.67	1.25	1.75	2.40
Cincinnati	3.68	2.66*cd*	2.66*cd*	....	.05	19.50	21.50	1.66	1.25	1.74	....
Cleveland	3.588*k*	3.10*k*	3.10*k*	.02½	.10	20.50	24.50	1.66	1.25	1.74	....
Dallas	4.25	3.17	3.17	....	....	25.50	27.50	1.93	1.42	2.03	....
Denver	4.577	4.34	4.25	....	....	28.00	.....	1.97	1.45	2.07	....
Detroit	3.661‡	2.50‡	2.50‡	....	.10	25.00	30.00	1.68	1.26	1.76	2.66
Kansas City	4.19	2.61*cd*	2.61*cd*	.0	.05	25.50	27.50	1.78	1.33	1.87	2.8738
Los Angeles	3.65*f*	2.575	2.425	.02½	.05	23.00	27.50	1.93	1.42	2.03	3.65
Minneapolis	3.872‡	2.79	2.79	.0	.10	21.00	23.00	1.80	1.34	1.89	2.79*d*
Montreal	3.95*i*	2.90*i*	2.80*i*	....	...	31.00*hi*	46.00*hi*	2.76	3.44*i*	2.82*im*	....
New Orleans	4.158‡*k*	3.59*k*	3.858	.05	.10	29.00	35.00	1.82	1.35	1.91	2.875
New York	3.75	2.76*e*	2.76*e*	....	.15	17.50	19.50	1.72	1.29	1.81	2.74
Philadelphia	3.666	3.668	....	....	....	20.50‡	22.50‡	1.71	1.28	1.79	2.72
Pittsburgh	2.10*a*	2.15*a*	2.15*a*	.02½	.10	23.00	26.50	1.59	1.20	1.67	2.40
St. Louis	3.697	2.74	2.74	.0	.05	28.00	34.00	1.69	1.27	1.78	2.70
San Francisco	4.35	2.825	2.675	.02½	.10	21.00	24.50	1.93	1.42	2.03	3.70
Seattle	2.75*e*	2.80*e*	....	....	....	34.50	38.50	1.93	1.42	2.03	2.95*e*

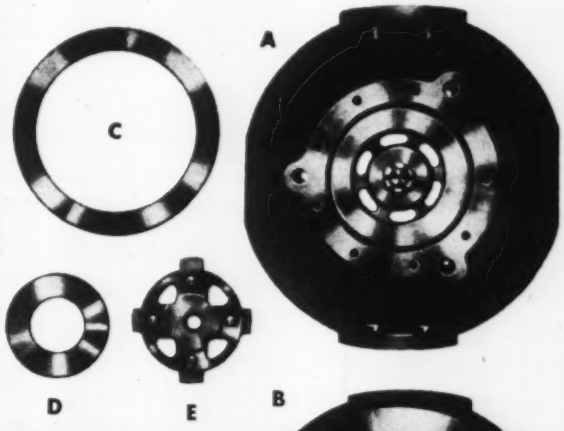
‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *k* Quotation on changed basis; no actual price change. *m* Per sq. yd.

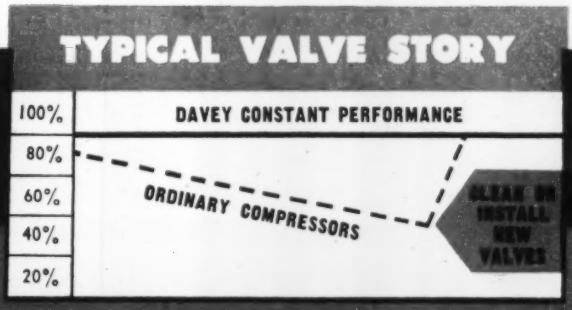
PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

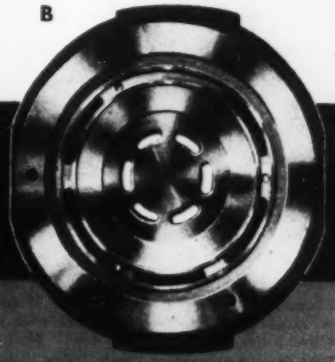
	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, std. 8 in., s.s.	Delivered std. 12 in., s.s.	ASTM 24 in.	C13-35 36 in.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14-35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in.; Lap Weld Black %	Galv. %
Atlanta	$56.40	$0.43*b*	$0.67	$3.39	....	$110.00	$140.00	$0.45	$2.00	48.2	54.2	59.7	51.2
Baltimore	60.80	.35	.60	2.70	$7.25	160.00	200.00	.75	2.00	65.5	57.5	63.0	54.5
Birmingham	52.00	.275	.495	1.95	5.50	100.00	220.00	.50	1.75	62.2	54.2	59.7	51.2
Boston	63.00	.392*r*	.756*r*	3.15*r*	7.995*r*	170.00‡*r*	265.00‡*r*	.46*t*	1.77*t*	....	....	....	....
Chicago	60.80	.40	.675	2.70	7.00	110.00‡	150.00‡	.45	1.85	66.0	55.0	64.5	53.0
Cincinnati	59.80	.308	.594	3.42	8.20	97.30	149.40	.36	1.60	57.1	43.4	54.0	39.6
Cleveland	61.20	.266*r*	.513	2.15	5.535	90.60	139.40	.36	1.60	68.5	57.5	66.0	54.5
Dallas	62.78	.31	.58	2.25	5.00	90.00	110.00	.46	1.57	....	....	....	....
Denver	67.72	.32	.576	2.376	....	143.00‡	264.00‡	.52	2.00	48	35	44	30
Detroit	61.20	.42	.81	3.15	8.50	170.00‡*r*	263.00‡*r*	.36	1.60	57.8	44.1	54.5	40.3
Kansas City	62.12	.35	.59	2.20	6.20	160.00	286.00	.45	1.60	35.61	46.13	46.21	59.43
Los Angeles	74.00	.325†	.585†	2.70	6.75	130.50	217.50	1.00†	2.00†	61.1	50.1	58.6	47.1
Minneapolis	64.10	.305†	.549†	2.196†	6.25†	....	....	.90	2.10	64.2	53.2	60.7	49.2
Montreal	67.00	.85*o*	1.50*o*	5.25*p*	8.50*ep*	45.00*m*	64.00*m*	.811*m*	2.51*m*	....	....	....	....
New Orleans	58.40	.37*r*	.78	1.69	....	150.00	220.00	.45	1.65	62.4	54.4	58.8	50.3
New York	60.20	.38	.75	3.06	7.88	....	....	.60	1.40	64.9	53.9	62.4	50.9
Philadelphia	58.90	.385	.75	3.06	8.00	180.00	250.00	.45	1.75	56.6	42.8	53.6	39.1
Pittsburgh	61.60	.287†*r*	.5535†*r*	2.475†*r*	6.4575*r*	124.20	193.80	.99	2.25*g*	68.5*i*	57.5*i*	66.0*i*	54.5*i*
St. Louis	59.40	.31	.558	2.232	4.95	93.50	242.00	1.00*j*	2.15*k*	68.5	57.5	66.0	54.5
San Francisco	74.00	.3625*d*	.6525*d*	2.61	6.52	115.00	192.50	.58	2.34	45.0	31.0	41.0	26.0
Seattle	75.80	.4125	.77	2.98	....	115.20	....	.51*f*	1.44*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, Burlington, N. J. (base) $57.00. Based on existing freight rates; subject to rate change. Gas pipe and class A. $3 per ton additional, 4 in., $5 per ton additional, 30 in. and larger usually $1 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.; ¾ in., 8¢.; ¾ in., 11½¢.; 1 in., 17¢.; 2 in., 37¢.; 2½ in., 58½¢.; 3 in., 76½¢.; 4 in., $1.09; 6 in., $1.92; 3 per cent tax on transportation costs not included. *i* Applies also at Lorain, Ohio mills Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh. Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt-weld—1 in. and 1¼ in. black 34 galv. 16; 1½ in. black 38 galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in. black 31½ galv. 14½; 4½ in.; to 8 in black, 32½ galv. 17. *j* Reinforced; spec. C 76–37. *k* Reinforced; spec. C 75–37. *l* Plus sales tax. *m* Centri. spun. *n* 27-in. pipe. *o* Less 50%. *p* Less 53%. *r* Truck delivery. *t* Full truck load lots. *u* Scarce: carload quantities not readily available.

These are Vital Parts of the Davey Valves that assure permanent peak efficiency





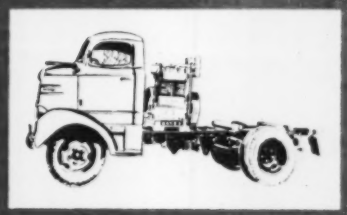


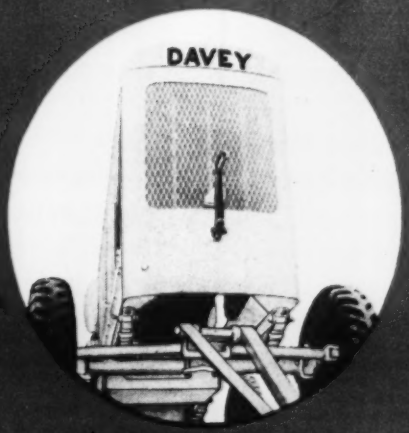
Look at the husky parts above and you'll see why Daveys built 5-10-15 years ago are running today with their original valves . . . why Davey is the only compressor with guaranteed LIFETIME VALVES.

"A" is the top of the Davey aluminum alloy cylinder head, "B" the bottom. "C" is the extra-capacity intake valve that fills cylinders fast for highest operating efficiency. "D" is the discharge valve and "E" the valve buffer. Davey owners seldom see these parts because they last . . . and last . . . and keep on delivering full volume of air.

See your Davey dealer today. Ask him to tell you more about LIFETIME VALVES. Ask him, also, about Auto-Air, the modern truck mounted compressor driven by the truck engine through the Davey Power Take-off. This unit occupies less than 1/3 of the truck body space, leaving the remainder for men, tools, materials . . . is today's best compressor buy.

DAVEY AUTO-AIR





DAVEY AIR-ARISTOCRAT

DAVEY

DAVEY COMPRESSOR CO., KENT, OHIO

There are Davey Dealers in Principal Cities

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR									LONG LEAF Y. P.		PLYWOOD	
	All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)									Merchantable grade up to 20 ft.		Rail freight increment (See note for base price)	
	All Fir planks No.2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)												
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	5/8"	3/4"
Atlanta	**$41.00**	**$41.00**	**$35.50**	**$38.50**	**$37.50**	**$41.50**	**$45.00**	.....	.....	$60.50	$64.00	$17.90	$21.85
	35.00	*35.00*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baltimore	**48.00**	**50.00**	**48.00**	**50.00**	**51.00**	**56.00**	**70.00**	.....	.....	125.00	130.00	18.25	22.25
	52.00	*53.00*	*59.00*	*59.00*	*59.00*	*62.50*	*75.00*	*$80.00*	*$80.00*	.....	.....	.....	.....
Birmingham	**50.00**	**50.00**	**49.50**	**48.50**	**49.50**	**52.50**	**73.00**	.....	.....	.....	.....	17.35	21.15
[1]	55.00	55.00	54.50	53.50	54.50	57.50	77.00	60.00	61.00	72.50	75.00	.....	.....
Boston	60.00[3]	60.00[3]	60.00[3]	60.00[3]	60.00[3]	62.00[3]	66.00[3]	.....	.....	.....	.....	18.25	22.25
	55.00	*55.00*	*54.00*	*54.00*	*54.00*	*54.00*	*58.00*	*58.00*	*58.00*	*58.00*	*58.00*	.....	.....
Chicago	**58.00**	**59.00**	**55.00**	**55.00**	**55.00**	**62.00**	**68.00**	.....	.....	90.00*l*	90.00*l*	14.60	17.80
	53.00	*53.00*	*54.00*	*54.00*	*54.00*	*55.00*	*56.00*	*56.00*	*57.00*	.....	.....	.....	.....
Cincinnati	**47.50**	**49.00**	**42.50**	**42.50**	**44.50**	**52.50**	**67.00**	.....	.....	65.00	65.00	17.35	21.15
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	**42.50***k*	**42.50***k*	**52.50***k*	**51.00***k*	**65.00**	**65.00**	**83.00**	**83.00**	**83.00**	.....	.....	17.75	21.60
Dallas	**45.25**	**45.25**	**44.50**	**43.00**	**43.00**	**47.25**	**60.75**	**58.75**	**58.75**	88.75	85.00	14.60	17.80
Denver	64.25[4]	64.25[4]	64.75[4]	65.25[4]	63.75[4]	64.75[4]	68.75[4]	*72.00*	*72.25*	.....	.....	10.45	12.70
Detroit	**61.00**	**61.00**	**57.75**	**57.75**	**57.75**	**63.75**	**71.00**	.....	.....	70.75	90.00	17.35	21.15
	57.00	*57.00*	*57.00*	*57.00*	*62.75*	*72.75*	*75.00*	*76.00*	*90.00*	.....	.....	.....	.....
Kansas City	**69.00**	**69.00**	**67.00**	**65.50**	**67.00**	**69.00**	**84.00**	.....	.....	84.00	94.00	12.60	15.40
	66.00	*66.00*	*59.50*	*59.50*	*59.50*	*59.50*	*75.00*	*80.00*	*80.00*	.....	.....	.....	.....
Los Angeles	*60.00*	*60.00*	*60.50*	*60.75*	*59.25*	*59.25*	*72.75*	*72.00*	*72.00*	.....	.....	9.90*gh*	12.05*gh*
Minneapolis	63.00[4]	62.00[4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.60	15.40
	63.00	*63.00*	*60.00*	*61.00*	*59.00*	*60.00*	*61.00*	*65.00*	*65.00*	.....	.....	.....	.....
Montreal	*64.00*	*65.00*	*60.00*	*63.00*	*65.00*	*70.00*	.....	.....	.....	.....	.....	.....	...
	90.00	*90.00*	*90.00*	*90.00*	*90.00*	*90.00*	*80.00*	*82.00*	.....	.....	.....	.....	...
New Orleans	**42.00**	**42.00**	**39.00**	**38.50**	**34.00**	**42.00**	**46.00**	.....	.....	54.50	69.00	14.60	17.80
	30.50	*30.50*	*30.00*	*30.00*	*29.00*	*29.00*	*28.50*	*29.50*	*29.50*	.....	.....	.....	.....
New York	[Range from **$75.00** to **$80.00**]						[**$80** to **$85**]	.....	.....	120.00*f*	125.00*f*	18.35	22.25
[2]	.....	.....	*65.00i*	*65.00i*	*65.00i*	*65.00i*	[Range from *$75* to *$95*]			.....	.....	.....	.....
Philadelphia	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	.....	.....	130.00	130.00	18.25	22.25
	75.00	*75.00*	*75.00*	*75.00*	*75.00*	*75.00*	*85.00*	*90.00*	*90.00*	.....	.....	.....	.....
Pittsburgh	**50.80**	**53.20**	**62.75**	**55.00**	**60.85**	**62.50**	**76.25**	.....	.....	120.00	130.00	18.10	22.05
	69.00	*68.10*	*66.10*	*65.30*	*65.20*	*65.75*	*82.75*	*88.75*	*88.75*	.....	.....	.....	.....
St. Louis	**61.00**	**61.00**	**57.00**	**56.00**	**57.00**	**59.00**	**71.00**	*75.00*	*75.00*	87.00	87.00	14.60	17.80
San Francisco	[*Range from $32.00 to $36.00*]				*34.00*	*34.00*	*34.00*	*34.00*	*33.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*45.50a*	*45.50a*	*45.75a*	*45.75a*	*44.50a*	*44.50a*	*47.75a*	*47.75a*	*46.50a*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [6] Spruce. [7] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* Ranges from $65 to $75. *j* Average price. *k* August 1943 price. *l* September price; none later available.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ½", $95.15; on ¾", $104.85; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness		EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	74%	75%	$0.15
Baltimore	78%	79%	.15
Birmingham	76%	76%	.105
Boston	77%	78%	.15
Chicago	77%	77%	.15
Cincinnati	77-10%	77-10%	.15
Cleveland	77%	77%	.19
Dallas	76%	76%	.1575
Denver	76%	76%	.155*e*
Detroit	77%	77%	.1575
Kansas City	77-10%	77-10%	.155
Los Angeles	86%*d*	88%*d*	.1575
Minneapolis	77%	77%	.155
Montreal	40-10-2%*ab*	50-2%*ac*	.1675†
New Orleans	70%	75%	.16
New York	80%	81%	.22*f*
Philadelphia	78%	79%	.15
Pittsburgh	79%	79%	.1225
St. Louis	77-10%	77-10%	.155 *
San Francisco	66%	73%	.155
Seattle	75%	75%	.1575†

Price of 60% Ammonia Gelatin in $0.01 per lb higher than 40%

a Discount from list Sept. 1939; sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1928.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal St. add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me	$0.105	$0.13	$0.15
W. of Miss. to Rocky Mtn. States, Fla. and Maine.	.11 -.1175	.135 -.1175	.155 -.1675
Rocky Mtn. States	.11 -.1225	.135 -.1525‡	.155 -.1725‡
Pacific N. W. States	.1075-.12	.1375-.15	.1575-.17
Pacific S. W. States	.1050-.1125	.135 -.1425	.155 -.1625

‡ F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES F.O.B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail Pine *	By Rail Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	.....
12 in.—2 ft. from butt	6-in.	50 to 59-ft.	.35	.....
12-in.—2 ft. from butt	6-in.	60 to 69-ft.	.36	.....
12-in.—2 ft. from butt	6-in.	90 to 100-ft.	...	.54
13-in.—3-ft. from butt	5-in.	91 to 100-ft.	...	.56
14-in.—2-ft. from butt	6-in.	50 to 69-ft.	.41	.63
14-in.—2-ft. from butt	6-in.	70 to 79-ft.	.43	.57
14-in.—2-ft. from butt	5-in.	80 to 85-ft.	.54	.....
14-in.—2-ft. from butt	5-in.	85 to 89-ft.	.57	.....
14-in.—2-ft. from butt	5-in.	90 to 100-ft.	...	.62

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.50	....	$2.00	....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.43/1.54	2.59	1.76	2.86
	Mixed Oak	1.71	2.59	2.42	3.58
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.45/2.65*a*	....	3.35/3.60
Los Angeles	Douglas Fir	2.00	3.25*a*	2.90	4.70*a*
Philadelphia	Red Oak	....	2.10*ag*	....	3.25*ag*
St. Louis	White Oak	1.70	....	2.40	....
	Red Oak	1.63	2.15*a*	2.19	3.25*a*
	Sap Pine or Cypress	1.70	....	2.06	....
San Francisco	Douglas Fir	1.25*bcf*	....	....	3.00*caf*
Montreal	Birch or Maple	....	1.65	1.04	....

Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 6"x8"x8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* F.o.b. cars. † Out of market. *g* January 1943 price, none later available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.50- 3.10
Chlorine cylinders, liquid, per lb., delivered	.0525
Calcium chloride, 77-80%, flaked, 100-lb. paper bag, del'd, ton	18.50-35.00
Silicate of soda, 52 deg. in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00-25.00
Sulphate of copper, in bbl., per 100-lb	5.00

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M lots of 2,000 pieces or over 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M in quantity Common backing	Straight hard	LIME Per ton. Hydrated finishing	In paper. Common hydrated	Carload lot. Pulverized, or lump
Atlanta	$110.00	$130.00	$230.00	$240.00	$270.00	$300.00	.....	$24.00	$17.50	$13.50	$15.04
Baltimore	84.00	90.00	170.00	200.00	260.00	300.00	17.00*k*	21.00*k*	19.00	14.50	2.50*m*
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	18.50	23.00	18.11	14.05	.....
Boston	105.00†	112.00†	210.10†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	85.80	91.70	172.60	.....*x*	.....*x*	.....*x*	17.00	18.00	17.00	15.00	12.50
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	27.75	27.75	15.50	13.00	.....
Cleveland	98.10	104.56	.....*x*	.....	.....	.....	22.75	22.75	15.75	13.25	.....
Dallas	71.40	76.40	145.30	183.50	238.00	294.50	15.25*i*	16.75*i*	19.00	15.00	15.00
Denver	99.00	112.00	185.00	214.00	248.00	294.00	21.50	.....	.....	.....	.....
Detroit	92.70	96.70	174.50	198.80	257.20	294.30	23.25*f*	23.25*f*	20.00	18.00	18.00
Kansas City	67.00	69.30	89.00*e*	128.00	163.00	189.00	17.50	18.50	19.32	13.00	10.92
Los Angeles	73.50†*r*	89.50†*r*	128.00*e*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	13.50	15.00	16.50	17.50	17.50
Minneapolis	.....	111.60*b*	186.25*b*	111.60	.....	.....	25.50	31.50*g*	24.00	16.00	19.00
Montreal	92.50*s*	98.50*s*	196.25*s*	151.50*s*	100.50*st*	134.50*st*	22.16†*u*	33.20†*u*	24.60*u*	15.00*u*	14.00*u*
New Orleans	104.50	109.55	207.25	222.25	326.90	385.65	17.75	.....	18.30	12.08	14.10
New York	99.40	106.00	145.75*e*	235.00*h*	287.40*h*	355.80*h*	19.50/20.50	.....	20.00	14.00	17.00
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	20.75	23.75	19.00	16.00	15.00
Pittsburgh	88.40	94.30	176.85	212.30	260.85	298.10	23.25	25.25*y*	17.90	15.40	2.55*m*
St Louis	67.00	72.00	130.00	190.00	244.00	290.00†	23.50	22.50	22.00	18.00	2.50*m*
San Francisco	96.00	108.00	144.00	108.00*e*	.....	.....	21.00	.....	18.50	18.50	1.85*m*
Seattle	115.00	125.00	230.00	125.00*t*	.....	.....	20.50*k*	24.00*k*	20.00*s*	20.00*s*	3.00*m*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6x12x12 in., 3-cell. *d* Not load bearing. *e* 48 lb. tile. *f* Includes $3.50 per M. for delivery. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* F.o.b. Warehouse only. *k* $1.00 discount. *l* Lump. *m* Per bbl., 180 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *r* 5% discount 10 days. *s* 2% discount for cash. *t* 5½ x 8 x 11½. *t* 5 x 8 x 12. *u* 8% sales tax included. *v* 6 x 12 x 12-in. *w* Per 200 lb. bag. *x* Not available. *y* Stacked.

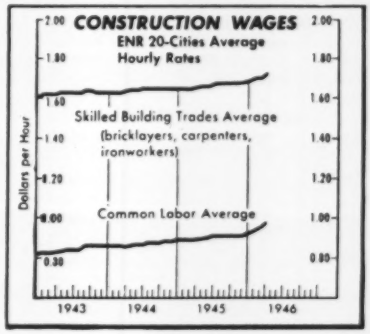
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *b*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b., factory Rolls, slate surfaced, 85–90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$10.25	$14.125	$1.30	$2.25	$1.20	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	10.00	13.75	2.00	3.00	2.50	2.30	2.70	2.70	.40	29.00
Birmingham	10.25	14.125	2.25	3.53	1.98	2.09	1.98	1.98	.32	28.35
Boston	10.00	13.75	1.75	2.50	2.31	2.00‡*h*	3.30‡*us*	3.30‡*us*	.25‡	21.00‡
Chicago	10.00	13.75	....	....	....	1.75*hf*	1.74*hf*	1.82*hf*	.33*f*	23.00*f*
Cincinnati	10.00	13.75	1.70	2.9	1.60	2.20	2.10*h*	2.10*h*	.33	25.00
Cleveland	10.00	13.75	1.70	2.90	1.60	1.71	1.63*h*	1.61*h*	.237	25.00
Dallas	10.00	14.50	1.88	2.11*n*	.05*l*	1.75*h*	1.66*h*	1.66*h*	.35	39.00
Denver	10.00	14.25	1.80	13.25*k*	16.15*k*	3.00	1.92*h*	1.92*h*	.29	29.00
Detroit	10.00	13.75	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	10.00	13.875	2.30*g*	2.55*g*	2.16*g*	2.19	2.30	2.30	.28	27.50
Los Angeles	10.25	14.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	10.00	13.875	....	....	....	1.7123*is*	1.6243*hs*	1.6243*hs*	.32	28.00
Montreal	.....	11.05	2.50*p*	4.90*p*	3.15*p*	2.71	2.45*t*	2.45*t*	.84*t*	1.83*kt*
New York	10.00	13.75	2.03	....	1.82	1.7098	1.6273*a*	1.6273*o*	.26	23.00
Philadelphia	10.00	13.75	1.60/1.80	2.20	1.55	2.25	2.71	2.71	.32	23.00
Pittsburgh	10.00	13.75	1.05	1.90	1.10	1.95	1.84*h*	1.84*h*	.34	26.00
St. Louis	10.00	13.75	2.28*s*	2.89*s*	1.96*s*	2.10	1.70	1.70	.45	23.00
San Francisco	10.25	14.00	1.80	2.75*n*	1.35	1.71	2.40	2.40	.33	20.50
Seattle	10.25	14.25	1.90	3.00	....	2.15	2.16*h*	....	.35	31.00*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 55 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per 100 lb. *l* Per lb. *m* Per bbl. *n* May, 1941 price. *o* 60-lb. roll. *p* Plus 8% sales tax. *s* December, 1942 price. *t* Federal tax included. *u* 90-lb. roll. *v* Truck delivery.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.75	$1.50	$1.625	$1.50	$1.50	$0.65	$0.65
Baltimore	1.90	1.675	1.90	1.625/2.00	1.725	.95	.95
Birmingham	1.75	1.375	1.625	1.50	1.65	.65	.65
Boston	1.725	1.60	1.725	1.50	1.667	1.15	1.15
Chicago	1.90	1.85	1.88	1.85	1.90	1.20	1.20
Cincinnati	1.825	1.60	1.725	1.45 /1.60	1.75	.90	.90
Cleveland	1.875*c*	1.65	1.875	1.875	1.875	1.085	1.125/1.155
Dallas	1.937	1.425	1.625	1.625	1.75	.70	.75 /1.25
Denver	1.80*b*	1.625	1.50*b*	1.625*b*	1.90	1.00	1.00
Detroit	1.90	1.625	1.825	1.675/1.825	1.775	1.15	1.15
Kansas City	1.75	1.575	1.70	1.70	1.75	.975	.90
Los Angeles	1.50	1.50	1.75	1.50	1.75	1.25	1.25
Minneapolis	1.625	1.50	1.625	1.60	1.725	.95	.95
New Orleans	1.625	1.375	1.625	1.55	1.50	.70	.80
New York	2.25*b*	2.10*b*	2.25	2.25*b*	2.00/2.25*b*	1.20	1.20
Philadelphia	2.00	1.58	1.90/2.00	2.25	2.00	.90	.90
Pittsburgh	2.00	1.75	1.75	1.8125	1.875	1.00	.90
St. Louis	1.90	1.70	1.90	2.20	1.90	1.00	1.00
San Francisco	1.875	1.75	1.75	1.50/1.75	1.75	1.00	1.00
Seattle	1.91	1.61	1.81	1.70	1.91	1.21	1.21
Montreal*	1.06	.96	1.01	1.01	1.06	.61	.66



b 7 hr. day. *c* Prevailing rate on government work.
* Cost of living bonus now included in basic wage.

ENR Skilled Average; (Bricklayers, Carpenters, Ironworkers) $1.743

ENR Common Average; $0.988.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BRIDGE OVER SPA CREEK ANNAPOLIS, MARYLAND

OWNER: Maryland State Roads Commission. Hardesty and Hanover, consulting engineers.

PROJECT: Construction of a bridge over Spa Creek between Eastport and Annapolis, Anne Arundel County, Maryland. Bridge measures 832 ft. from the North abutment to the South abutment. Steel I-beam construction on 12 concrete-pile bents, 55 ft. apart, plus two piers supporting a double leaf steel bascule with 40-ft. waterway clearance and a 15-ft. headway clearance from mean low water. The bridge will support a 26-ft. clear roadway with two sidewalks six feet wide.

BIDS: Six bids were received on January 17, 1946, ranging from the contract low of $667,696.50 to $922,253.00.

LIST OF BIDDERS:

1. McLean Contr. Co., Baltimore, Md. (contract) .. $667,696.50
2. Whiting-Turner Contr. Co., Baltimore, Md. 747,850.93
3. Johnson, Drake & Piper, Inc., N.Y.C. 793,559.50
4. Tuller Construction Co., Red Bank, N. J. 798,864.00
5. Baltimore Contr. Co., Baltimore, Md. 824,041.00
6. Melwood Contr. Corp., N.Y.C. 922,253.00

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Maintenance of Traffic	L.S.	$1,500.00	$106,050.00	$5,000.00
2. Class #2 Excavation	350 cu. yd.	2.00	2.85	3.00
3. Class #3 Excavation	180 cu. yd.	5.00	32.20	4.00
4. Class #4 Excavation	70 cu. yd.	6.00	24.70	6.00
5. Borrow Excavation	3,100 cu. yd.	1.00	1.26	2.00
6. Tamped Fill	610 cu. yd.	1.00	1.50	2.00
7. Selected Backfill	150 cu. yd.	7.00	6.60	4.00
8. Porous Wall Backfill	40 cu. yd.	10.00	7.00	8.00
9. Unt. Cl. A. Timber Piles	1,690 lin. ft.	1.20	1.89	1.50
10. Unt. Tim. Test Piles	315 lin. ft.	2.00	2.94	3.50
11. Tr. Cl. A. Piles—Fenders	4,000 lin. ft	2.50	3.15	4.00
12. Tr. Timber in Fenders	12 M.B.M.	350.00	415.00	400.00
13. Metal in Fenders	14,000 lbs.	.40	.26	.15
14. 24 in. Prec. Conc. Piles	11,030 lin. ft.	11.00	12.86	11.50
15. 24 in. Prec. Conc. Test Piles	470 lin. ft.	15.00	19.95	20.00
16. Load Tests—24 in. Precast Conc. Test Piles	2 ea.	3,000.00	1,155.00	2,000.00
17. 18 in. Prec. Con. Piles	2,975 lin. ft.	8.00	9.24	8.00
18. 18 in. Prec. Con. Test Piles	75 lin. ft.	10.00	10.50	10.00
19. Prot. Coat-Con. Work	2,000 SF	4.00	1.20	1.00
20. Dampproofing	2,000 SF	.20	.12	.10
21. Cast Iron Bal. Blocks	20,000 lb.	.15	.10	.10
22. Cl. X. Found. Seal	40 cu yd.	25.00	27.85	40.00
23. Cl. A. Conc. in Abut. and retaining walls	450 cu. yd.	50.00	39.50	55.00
24. Cl. A. Conc. in Pile Caps	140 cu. yd.	50.00	58.80	55.00
25. Cl. A. Con. Rdway—Slabs—bridge	620 cu. yd.	60.00	59.50	50.00
26. Cl. A. Con. bascule Piers & Houses	560 cu. yd.	60.00	63.50	50.00
27. Cl. A. Con. Counterwghs	60 cu. yd.	40.00	37.25	40.00
28. Rein. Steel Bars	335,000 lb.	.10	.057	.08
29. Fab. Struct. Steel in Bas. Spans, towers, count	330,000 lb.	.18	.1443	.15
30. Fab. Struct. Steel in Flank Spans and Approaches	1,100,000 lb.	.105	.082	.11
31. Miscellaneous Metal	20,000 lb.	.40	.171	.30
32. Open Grat. In Rdway	1,360 SF	4.50	3.80	3.00
33. Open Grat. in Sdwalk	440 SF	4.00	3.06	3.10
34. Fill Grat. in Sdwalk	120 SF	5.00	3.60	3.50
35. Water Service Line	L.S.	3,800.00	3,664.00	10,000.00
36. Control House	L.S.	15,000.00	14,961.00	30,000.00
37. Trunnions and Bearings	1,200 lb.	.70	.60	1.00
38. Operating Machinery	35,000 lb.	1.00	.825	1.25
39. Traffic Gates	L.S.	2,500.00	3,150.00	10,000.00
40. Lamp Poles	16 each	75.00	95.10	2,400.00
41. Roadway Lighting Units	16 each	35.00	38.13	50.00
42. Roadway Light. System	L.S.	3,000.00	3,553.20	15,000.00
43. Elc. Equip. Bas. Span	L.S.	30,000.00	30,924.00	79,000.00
44. Bridge Operator	L.S.	500.00	1,925.00	2,500.00
45. Clearing and Grubbing	L.S.	500.00	368.00	1,000.00
46. Class #1 Excavation	780 cu. yd.	1.00	1.26	1.25
47. Rem. Exist. Masonry	5 cu. yd.	15.00	20.00	50.00
48. Mac. Base Course—6 in.	350 SY	2.00	1.74	1.50
49. Gravel Surface Course	100 SY	1.70	1.58	1.00
50. Gravel Surf. Crse. Maint. of Traffic	50 cu. yd.	4.00	6.00	6.00
51. Pen. Mac. Surface Crse	350 SY	1.50	1.37	1.50
52. Bit. Mat. for Pen. Mac	900 Gal.	.20	.21	.25
53. Reinf. Cem. Conc. Pavement 9-7-9—Cl. A. Reg.	1,050 SY	4.25	4.36	5.00
54. Reinf. Cem. Conc. Pavement 9 in. Class A. Reg.	1,000 SY	4.75	4.73	5.50
55. Reinf. Cem. Conc. Pavement 9 in. Class X. Early Str.	180 SY	5.50	5.52	6.00
56. 15 in. A.C.C. Metal Pipe	81 lin. ft.	3.00	2.89	4.00
57. 18 in. A.C.C. Metal Pipe	136 lin. ft.	3.50	3.41	4.50
58. 13 in. rise Span and 22 in.—A.C.C. M. Pipe	136 lin. ft.	4.50	4.10	5.00
59. 18 in. Rise and 29 in. Span A.C.C. M. Pipe	196 lin. ft.	5.50	5.25	7.00
60. Rem. Old Pipe Culverts	50 lin. ft.	1.50	1.58	1.50
61. Relaid Old Pipe Culvert	50 lin. ft.	2.00	1.58	1.50
62. Cl. A. Con. Pipe Endwalls	3 cu. yd.	60.00	63.00	50.00
63. Pl. Com. Curb and Gutter Class A Reg.	1,180 lin. ft.	2.20	2.10	2.25
64. Conc. Sidewalk Reg. Conc. Class A	4,900 SF	.50	.45	.50
65. Guard Rail Chain	190 lin. ft.	1.00	.95	2.00
66. Cedar Posts	46 each	6.00	6.30	5.00
67. Manhole, Frame and Cover	1 each	60.00	157.50	500.00
68. Type H. Comb. Inlets	8 each	40.00	131.25	450.00
69. Dredging	1,800 cu. yd	1.50	2.58	3.00
70. Rem. and Disp. Ex. bridge	L.S.	5,000.00	20,351.00	36,000.00
71. Stnd. Cl. and E. Comb. Inlet	2 each	150.00	157.50	250.00

HIGHWAY IMPROVEMENT HEMPSTEAD CO., ARKANSAS

OWNER: Arkansas State Highway Department, Little Rock. Mr. N. B. Carver, engineer.

PROJECT: Highway improvement of 10.9 mi. between Hope and Lewisville, Hempstead County, Ark.; including grading, minor drainage structures and gravel base course.

CONDITIONS: Contractor to furnish all materials and complete work in 120 working days. Rail and highway transportation facilities available. Wage rates are: $1.00 per hr. for skilled labor; 65c. per hr. for semi-skilled; and 40c. per hr. for common labor.

BIDS: Seven bids were received on January 21, 1946, ranging from the contract low of $51,299.38 to $68,926.80.

LIST OF BIDDERS:

1. R. H. Davis, Stamps, Arkansas (contract) $51,299.38
2. D. F. Jones, Little Rock, Ark. 57,853.23
3. Reynolds & Williams, Tyler, Tex 59,946.16
4. Graves Bros., Hamburg, Ark. 63,961.27
5. East Arkansas Construction Co., Jonesboro, Ark. 65,925.05
6. Mears Construction Co., Osceola, Ark. 66,795.88
7. R. DeLaughter, Prescott, Ark. 68,926.80

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing	1,000 acres	$150.00	$100.00	$100.00
2. Grubbing	1,000 acres	75.00	100.00	100.00
3. Common excavation	2,346 cu. yd.	.30	.40	.52
4. Dry excavation for structures	594 cu. yd.	2.00	2.00	2.75
5. Wet excavation for structures	228 cu. yd.	4.00	3.00	2.75
6. Embankment material	15,295 cu. yd.	.32	.39	.50
7. Overhaul compacting	500 sta. yd.	.02	.02	.02
8. Earthwork gravel base	15,295 cu. yd.	.03	.02	.10
9. Course (Cl. B-8)	19,446 cu. yd.	1.00	1.15	1.05
10. Class "A" Concrete	428.24 cu. yd.	37.50	30.00	33.00
11. Class "B" Concrete	16.89 cu. yd.	35.00	30.00	35.00
12. Reinforcing steel	38,793 lb.	.045	.08	.09
13. Reinforced concrete pipe. culvert 18 in.	92 lin. ft.	3.00	3.00	2.50
14. Reinforced concrete pipe, culvert 24 in.	64 lin. ft.	3.50	4.00	3.50
15. Reinforced concrete pipe, culvert 30 in.	16 lin. ft.	5.00	6.00	5.00
16. Relaying culvert pipe	18 lin. ft.	1.50	1.50	2.00
17. Concrete spillways	1.68 cu. yd.	35.00	40.00	20.00
18. Solid sodding	16,000 sq. yd.	.25	.40	.35
19. Remove existing bridges	2 each	200.00	250.00	75.00

Insure Safe, Positive Lubrication with ALEMITE EQUIPMENT

● This new line of Alemite Equipment was developed specially for the construction industry. It's built *rugged* to take a beating, have long life and give uninterrupted operation.

There's a piece of Alemite Equipment for every purpose, to handle all types of lubricants in any temperature. You assure the proper handling and application of greases and oils, and eliminate contamination and waste.

It all adds up to longer life and greater efficiency for your machines.

Shown here is some of the equipment in the new line. For additional information, write Alemite, 1821 Diversey Parkway, Chicago 14, Illinois.

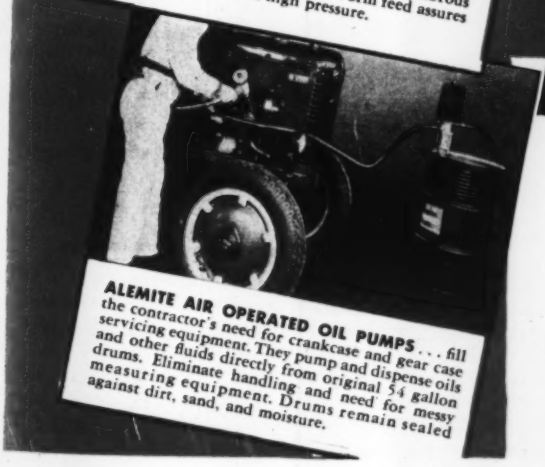
ALEMITE LEVER GUNS . . . equipped with a loader valve which permits rapid and positive refilling without need for disassembly . . . without mess or waste. High pressure (up to 10,000 lbs.) makes it possible to serve difficult bearings with the minimum of manual effort.

ALEMITE LOADER PUMPS . . . the one shown is used to fill hand guns from the original 100-lb. lubricant drum. (Also available in 35-lb. capacity container.) The loader prevents air pockets in the gun, which results when hand paddle methods are used. It ends waste and contamination of lubricants. It saves time, eliminates handling, is easy to operate.

ALEMITE VOLUME PUMPS . . . Designed for track roller and idler bearing lubrication, and all points requiring a volume of lubrication. Pump has a capacity of 35 lbs. It develops 3500 lbs. pressure. Easily pumps all grades of light-bodied or semi-solid lubricants that seek their own level. Protects lubricant from dirt and moisture.

ALEMITE HIGH PRESSURE PUMPS . . . These air operated pumps serve the heavy duty requirements of the construction industry for power lubrication when extensive lubrication needs make manual methods impractical. Handle a volume delivery of heavy fibrous lubricants even at low temperatures. Worm feed assures positive volume delivery at high pressure.

ALEMITE TRANSFER PUMPS . . . A clean, rapid method of handling petroleum products. Transfers oil, grease and other fluids from their original containers without mess or waste. The original containers remain sealed against dirt, moisture, and foreign particles.



ALEMITE AIR OPERATED OIL PUMPS . . . fill the contractor's need for crankcase and gear case servicing equipment. They pump and dispense oils and other fluids directly from original 5/4 gallon drums. Eliminate handling and need for messy measuring equipment. Drums remain sealed against dirt, sand, and moisture.

NEW FREE BOOKLET

"Correct Lubrication in the Construction Industry"

Contains valuable lubrication information—needs of many types of machines—proper selection of special lubricants . . . best methods of application . . . quick facts on various lubricants. Handy size to keep for ready reference. Send for your copy today.

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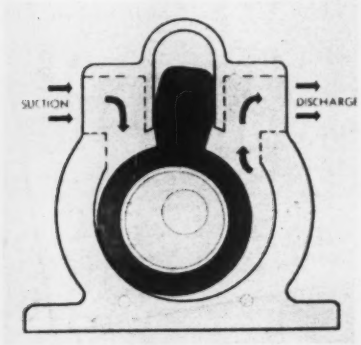
MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Gearless Pump

Equipped with special bearings which require only water lubrication, an improved gearless pump handles water light oil or other liquids. This bronze pump can be mounted at any angle and



operated in either direction; opening of the face plate allows quick removal of any obstructions.

The removable impeller, composed of layers of laminated sections vulcanized together, enables gritty particles to pass without harm to the pump. This machine is available with single impeller and standard ½-in. connection.—*Eco Engineering Co., 12 New York Ave., Newark 1, N. J.*

• • •

Rock Blasting

A new system of rock blasting, promising increased tonnage, reduced secondary blast and cleaner back break, has been announced. This "Rockmaster" system is designed around an entirely new "Rockmaster" blasting device, and requires changes from previous methods in spacing burden and explosive selection.

The system is said to produce superior fragmentation and to leave a clean rock face.—*Atlas Powder Co., Wilmington, Del.*

• • •

Air Separator

A new combination air separator and trap for users of compressed air tools and operations is now in production. It utilizes the centrifugal principle. Air entering the inlet is diverted positively to the inner wall of the round body and unwanted substances whirl out of the air stream and drain to the bottom. The cleaned air may be taken off horizontally or vertically from pipe-tapped ports. An integral float-operated trap releases condensate automatically. Separator is made of high-tensile iron; interior parts of corrosion-resisting materials. It is made in three sizes for varying capacities and with a range of pipe connection sizes.—*The Swarthout Co., 18, 511 Euclid Ave., Cleveland 12, Ohio.*

• • •

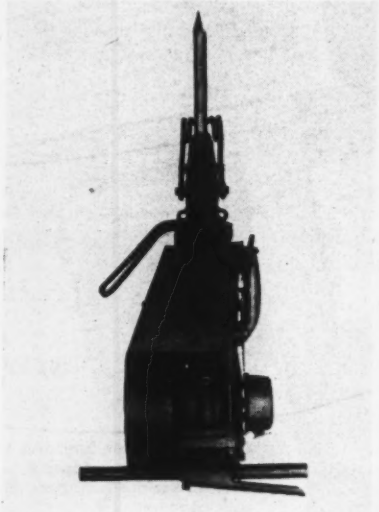
Automatic Clutch

To eliminate the sudden shock of starting machinery or moving equipment, a new Salsbury automatic clutch can be installed on the shaft of any engine or electric motor. This device, by centrifugal action, progressively applies power to the driven machine and engages and disengages without human control. The clutch, available in a model for the range of fractional up to 3 hp., and one for up to 6 hp., is an opposed shoe type, dual-spring balanced.—*Salsbury Motors, Inc., 4464 District Blvd., Los Angeles 11, Calif.*

• • •

Self-Contained Paving Breaker

With a nose-end arrangement redesigned to utilize the resiliency of a spring-tool retaining clip, an improved

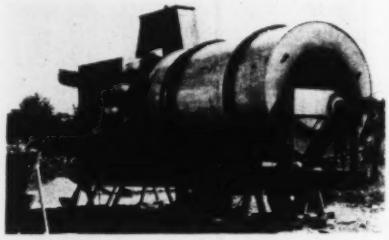


version of the Syntron self-contained, portable gasoline hammer paving breaker is now available. Advantages claimed for the spring clip arrangement are: easy spring action of the breaker when used at maximum over-travel; a quick and easy method of changing tools; and elimination of broken retainer latches, nose castings, etc.—*The Syntron Co., 328 Lexington Ave., Homer City, Pa.*

• • •

Portable Asphalt Plant

Streamlined, portable and with a capacity of 20 to 40 tons per hour, the new "Overman" asphalt plant can be moved by any commercial tractor which has a fifth wheel. Aggregate goes in at



the front of the drier, passes through the inside cone, then back to the front of the drier, where it is picked up by the elevator and dumped into the mixing chamber. It is fed from reciprocating feeder plates, one for sand and the other for stone, in controlled amounts.

All moving parts are synchronized except the asphalt pump, which is set by a special chart from 3 to 8 percent. The one-man-operated plant is 25 ft. long and weighs 8 tons.—*Komb Drier Co., 412 South Gallatin St., Marion, Ind.*

• • •

Power Winch

Greater safety and ease in loading heavy machinery and materials is to be expected by the use of a new type power winch, a compact unit easily mounted on trucks and trailers. Sizes are available with 12,000, 18,000 and 25,000-lb. capacities. Power is provided by the truck engine. Three operating levers are in the cab. Units are equipped with an oil-cooled, fully adjustable automatic brake. —*Fruehauf Trailer Co., 1040 Harper Ave., Detroit 32, Mich.*

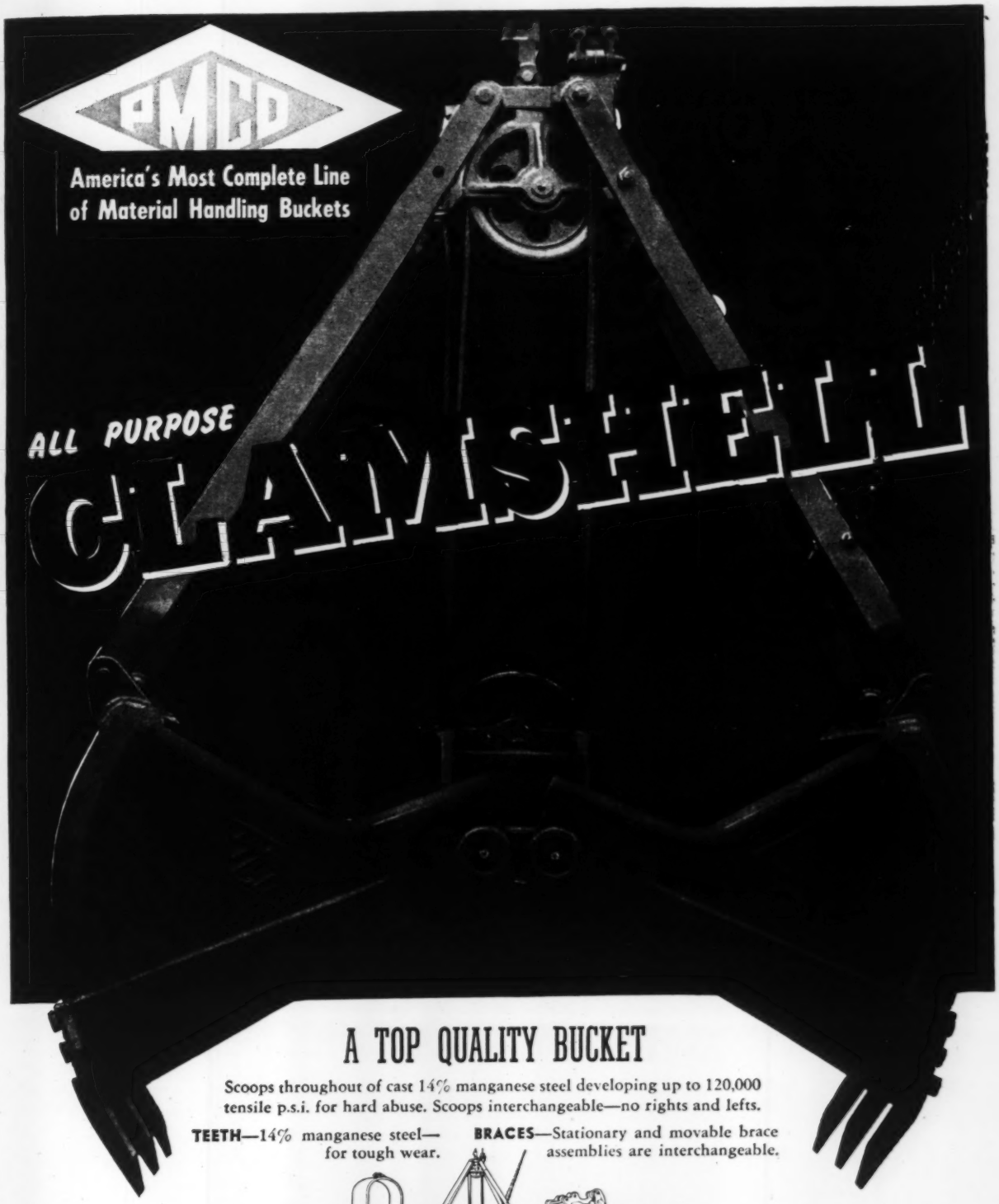
• • •

Truck Crane Combination

A wheel mounted, two-motor crane is designed to permit immediate transfer of traveling and steering functions from chauffeur's cab to crane operator's cab. Known as the "Tu-Control" crane, the unit is operated from the chauffeur's cab at truck speed when traveling overland or through congested areas. Upon arrival

PMCo

America's Most Complete Line of Material Handling Buckets



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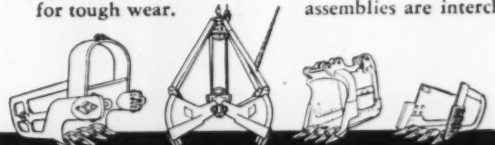
Scoops throughout of cast 14% manganese steel developing up to 120,000 tensile p.s.i. for hard abuse. Scoops interchangeable—no rights and lefts.

TEETH—14% manganese steel—for tough wear.

BRACES—Stationary and movable brace assemblies are interchangeable.



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WE MAKE ALL FOUR BUCKETS

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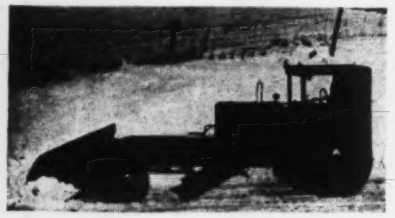
PETTIBONE MULLIKEN CORP. CHICAGO 51, U. S. A.

at the job, where the crane operator requires full control over his machine, the truck functions are taken over by him through the "Tu-Control" mechanism. Hand and other signals are not necessary. —*The Browning Crane & Shovel Co., East 163rd & Waterloo Road, Cleveland 10, Ohio.*

• • •

V-Type Snow Remover

This V-type snow plow powered by a tractor becomes an efficient dual-purpose snow remover. Its regular blade supple-



ments the snow clearing action when in down position and can be used to bench the snow on side bank when raised.

The plow with its expanding curve moldboard has a cutting width of 72 in. It is raised and lowered hydraulically. The maintainer blade is 10 ft. long and has a swing of 90 degrees. It has a side shift of 15 in., clearance of 12 in., and penetration of 5 in.—*International Harvester Co., 180 No. Michigan Ave., Chicago 1, Ill.*

• • •

Hot Spray Bar

Many advanced features of construction and design are claimed for a new hot spray bar, for distribution of bituminous materials.

The manufacturer states that this new bar is of double construction, the material entering the inner pipe which carries the material to the very ends of the bar, from which points it circulates back through the entire length of the outer pipe, and on out the spray nozzles, or back into the supply tank. This circulation of material is constantly under positive pressure from a rotary pump.—*The Cartwright Asphalt Equipment Co., North Robinson, Ohio.*

• • •

Fire Extinguisher Installation Guide

A new guide has been developed to indicate what types of extinguishers should be installed for the different kinds of fires that may break out. This illustrated guide divides fires into the standard A, B and C classifications. Measuring 8½x20 in., the chart has a gummed edge for posting over every extinguisher in the plant.—*Randolph Laboratories Inc., 8 East Kinzie St., Chicago 11, Ill.*

Reports and Pamphlets

(*Continued from page* 112)

OF TASKS ACCOMPLISHED: The story of accomplishments in World War II, and BUILDERS IN STEEL. Both published by the Dominion Bridge Company, Montreal, Que.

AIRPORT ACCOUNTS—By Joseph M. Cunningham, Municipal Finance Officers Association, Chicago 37, Ill., $1.25.

1945 LAWS BULLETIN—A Digest of New Legislation Affecting Highway Users—National Highway Users Conference Inc., National Press Building, Washington 4, D. C.

OPPORTUNITY UNLIMITED—A Guide for Veterans Interested in the Construction Industry. Prepared for the Committee on Opportunities for Veterans in the Construction Industry by Van Rensselaer Sill. Copies can be obtained from E. L. Chandler, Room 703, 1026 17th St., Washington 6, D. C. 10c.

RIVER REGULATION IN THE BLACK RIVER REGULATING DISTRICT—Board of the Black River Regulating District, Watertown, N. Y.

TRANSPORTATION, THE BULWARK OF THE AMERICAN ENTERPRISE SYSTEM—Transportation Association of America. 105 W. Adams St., Chicago 3, Ill. 10c.

STUDY OF TIMING OF PUBLIC WORKS IN CALIFORNIA—State Reconstruction and Reemployment Commission, 631 J Street, Sacramento 14, Calif.

AIRPORT DEVELOPMENT PLAN—St. Louis Metropolitan Area. Prepared for the City of St. Louis Airport Commission, St. Louis, Mo.

COLUMBIA BASIN—Highway Development—U. S. Bureau of Reclamation. Superintendent of Documents, Washington 25, D. C. 15c.

HOUSING AFTER WORLD WAR I—National Housing Bulletin No. 4, National Housing Agency, Washington, D. C.

FOOD AND IRRIGATION—Problems Affecting India in General and Bombay in Particular. By Rao Bahadur N. S. Joshi, 1287 Shivaji-Nagar, Poona 4, India.

OFFICIAL TRAFFIC ORGANIZATIONS in Cities and States—A Survey Conducted by ENO Foundation for Highway Traffic Control, Saugatuck, Conn.

DE RECHTSTREEKSCHE BEPALING VAN DE MEEST-ECONOMISCHE AFMETINGEN VAN EXCENTRISCH BELASTE GEWAPEND-BETON KOLOMMEN — By C. J. Van Mansum, Boisotkade No. 9, Leyde, Holland.

LOS PRIMEROS ESTUDIOS EN EL RIO DE LA PLATA SUPERIOR—Union Industrial Argentina Buenos Aires, Argentina.

NEW JERSEY STATE HIGHWAY DEPARTMENT —A Report for 1944, Trenton, N. J.

NEW JERSEY STATE HIGHWAY DEPARTMENT —Financial Report, Jan. 1, 1944 to June 30, 1945.

BUREAU OF SANITARY ENGINEERING OF THE MARYLAND STATE DEPARTMENT OF HEALTH, Annual Report for 1944. Baltimore, Md.

EIGHTEENTH ANNUAL HIGHWAY CONFERENCE —Highway Series No. 18, Engineering Experiment Station, University of Colorado, Boulder, Colo.

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N. J.... Trenton—Ross, Young, Dilts Company
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R. I.... Providence—Tractors, Inc.
S. C.... Columbia—N. H. Summers Road Machinery Co.
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8 OVERLAPPING FORWARD SPEEDS give Adams Motor Graders exactly the right "gait" for every type of grading operation . . . for ditch and bank cutting—for blading and scarifying—for aggregate mixing and spreading . . . plus transport speeds up to 21 m.p.h. for fast moving from job to job.

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What's more, in Adams Motor Graders you get a host of other features essential to efficient, long-life performance . . . rugged strength—rigidity—balanced weight distribution—fast, accurate blade controls—wide range of usefulness—minimum operating and maintenance costs.

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J. D. ADAMS MANUFACTURING CO., *Indianapolis, Indiana*

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See ad on page 129 for list of equipment in each line

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Utah, Salt Lake City, J. K. Wheeler Mach. Co.
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La., New Orleans, Ole K. Olson Company
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Mich., Detroit, T. G. Abrams
Mo., Kansas City, Brown-Strauss Corp.
Neb., Lincoln, Highway Equip. & Supply Co.
N. J., Newark, Johnson & Dealaman
N. C., Raleigh, Smith Equip. Company
O., Cleveland, H. B. Fuller Equip. Company
Pa., Philadelphia, Giles & Ransome
Wilkinsburg, Arrow Supply Company
Tex., El Paso, Mine and Smelter Supply Company
Houston, McCall Tractor & Equip. Company
W. Va., Charleston, Clyde P. Beckner, Inc.

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Little Rock, R. A. Young & Son
Ind., Indianapolis, Reid-Holcomb Company
Iowa, Des Moines, Electrical Eng. & Const. Co.
Ky., Harlan, Hall Equipment Sales Company
Louisville, Williams Tracter Company
La., New Orleans, Wm. F. Surgi Equip. Company
Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
Flint, Granaden-Hall & Company
Mo., Kansas City, Mach. & Supplies Co.
N. J., Hillside, P. A. Drobach
No. Bergen, American Air Compressor Corp.
N. M., Roswell, Smith Machinery Company
N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental & Sales
Olean, Freeborn Equip. Company
N. C., Raleigh, Carolina Tractor & Equip. Co.
O., Cleveland, Gibson - Stewart Company
Toledo, The Kilcorse Mach. Co.
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Harrisburg, American Equip. Corp.
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Wyoming, Cheyenne, Wilson Equip. & Supply Co.

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Worthington Pump and Machinery Corp.

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Holyoke, Massachusetts

Elections and Activities

The Colorado Society of Engineers has elected the following officers and directors for the year 1946: president, Dana E. Kepner; vice-president, Paul K. Seyler; secretary-treasurer, C. M. Lightburn; directors, R. W. Lindsay, Ralph N. Tracy, G. H. Garrett, A. A. Matthews, C. E. Dobbin, Adolph Zulian, John McGowan and Ralph B. Hubbard.

D. E. Kepner

Officers of the Idaho branch of Associated General Contractors of America are: W. H. Puckett, vice-president of Morrison-Knudsen Co., Boise, president; Ernest White, Twin Falls, vice-president; A. D. Stanley, and R. B. Lewiston, Boise, new directors; and L. D. Robbins, Boise, secretary-treasurer.

W. H. Puckett

The following officers have been chosen for the Springfield Chapter of the Illinois Association of Highway Engineers: President, T. H. F. Norris, assistant construction engineer, District 6, Division of Highways; vice-president, George B. Jones, assistant engineer, bureau of design, Division of Highways; secretary, E. J. Raich, assistant maintenance engineer, District 6; treasurer, W. A. McCree, assistant highway research engineer, District 6.

J. R. Shelburne, Springfield, succeeds Earl Guy, Springfield, as chairman of the board of directors of the Illinois Association of Highway Engineers. Other officers are: R. J. Kenyon, Elgin, vice-chairman; T. O. Cremeenes, Carbondale, secretary; W. M. Waller, Paris, treasurer; and D. S. Magowan, Chicago, delegate to the Illinois Engineering Council.

The Builders and Traders Exchange of Sheboygan, Wis., has elected the following officers; president, Ray Quasius; vice-president, Arthur Meier; treasurer, David Holler; and secretary, Edwin Daane.

Officers of the South Jersey Chapter of the N. J. Society of Professional Engineers are: Daniel M. Kramer, president; Alonzo L. Jones, West Orange, first vice-president; Hugh C. Clarke, Jersey City, second vice-president; National society directors, C. George Krueger, Jersey City; Joseph M. Cerreta, Roselle Park and Curtis C. Colwell, Caldwell, national society director (alternate) Frank C. Mirgain, Highland Park, N. J. and trusteee-at-large Frederick W. Doede, Jr., Passaic, N. J.

The Illinois Society of Engineers has changed its name to The Illinois Society of Professional Engineers. George H. Anderson, Herrin, consulting engineer, was elected president to succeed J. Holloway Morgan, district engineer, Illinois State Geological Survey. Duncan M. Campbell, Cook County highway engineer, Chicago, was named vice-president. Prof. H. E. Babbitt, department of civil engineering in charge of sanitary engineering, University of Illinois, was re-elected secretary. Prof. W. A. Oliver, department of civil engineering, University of Illinois, was named representative to the National Society of Professional Engineers, and was re-elected editor of "The Illinois Engineer".

The Illinois Contractors Association, meeting at Springfield recently, elected officers as follows: Fred W. Shappert, Jr., Belvidere, president; James F. Keeley, East St. Louis, vice-president; Thomas H. Joyce, Jr., Springfield, treasurer; A. C. Hoeffken, Belleville, member of the board of directors.

J. E. Tweddle, former city commissioner, recently was named an honorary member of the Calgary Alta., General Contractors' Association.

Georgia Society of Professional Engineers, meeting at Savannah recently, installed A. M. Gruber as president. F. M. Byck is vice-president; B. R. Tyler is treasurer, and J. F. Inglesby, secretary.

R. F. Rasey, of Los Angeles, Calif., is the new president of the Southern California Chapter of the Associated General Contractors. Other new officers are: John A. Kier, first vice-president; John S. Reynolds, second vice-president; Frank C. Wood, third vice-president; and William Curlett, treasurer. W. D. Shaw continues as manager.

F. C. Bolton, vice-president and dean of engineering at Texas A. & M. College, and E. P. Schoch, acting director of the

IT'S A STUBBORN BRUTE AND THAT'S GOOD!

You can give this Blue Brute 315′ Compressor the toughest jobs on your books and it won't cry for help until you've got your money out of it many times over.

Take, for example, the three-point suspension of engine and compressor in a single housing — it's a Worthington feature that maintains alignment regardless of shock and vibration. Take the Worthington Feather* Valve — it will stay tight-seating and quiet for a lifetime. Take the full force feed lubrication of engine and compressor — it keeps all moving parts in constantly healthy condition. Investigate those vital features!

Teamed up with those versatile Worthington Wagon Drills (that make holes in any direction and at any angle) or other Blue Brute Air Tools, your Blue Brute Compressor will supply *more air* per gallon of fuel — and will stay trouble-free no matter how tough the going.

Make a date with your near-by Worthington distributor so that he can give you the rest of the facts that prove *there's more worth in Worthington.*

*Reg. U. S. Pat. Off.

H6-4

KNOW YOUR BLUE BRUTES

Your Blue Brute Distributor will gladly show you how Worthington-Ransome Blue Brute construction equipment will put your planning on a profitable basis. His name is listed on page 128. Blue Brutes include:

RANSOME EQUIPMENT

Pavers, Concrete Spreaders and Finishers*, Portable and Stationary Mixers, Pneumatic Placing Equipment, Truck Mixers, Plaster and Bituminous Mixers and accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel driven Portable Compressors, Rock Drills, Air Tools, Contractors' Pumps* and accessories.

*To be announced

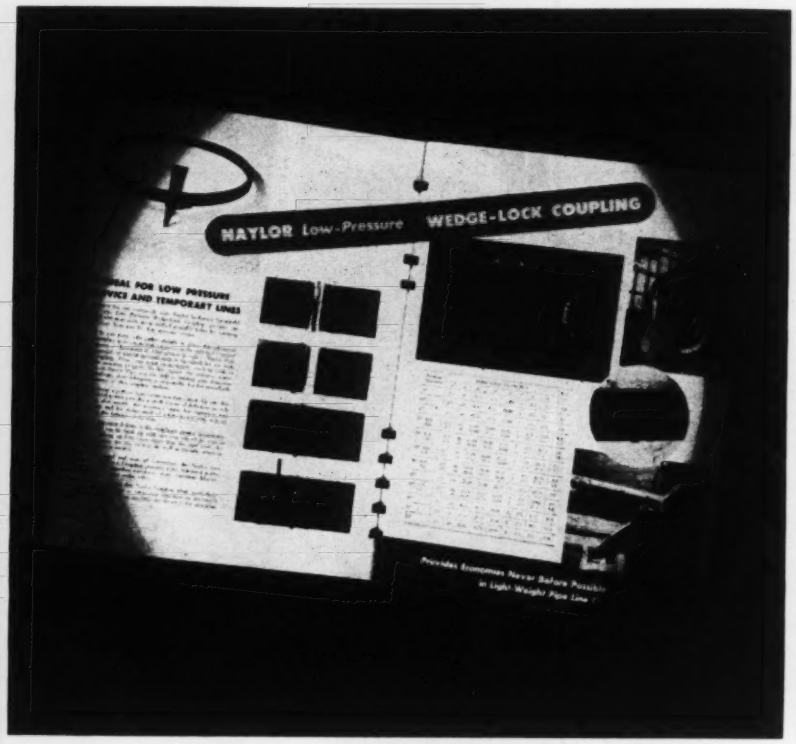
Get more WORTH from air with WORTHINGTON

BUY BLUE BRUTES

Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

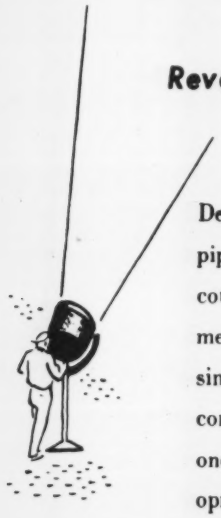
Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division Holyoke, Mass.



SPOT-LIGHT NEWS

for Contractors

Revolutionary New Pipe Coupling Saves Time and Money on Low-Pressure or Temporary Lines



Designed for use exclusively with Naylor light-weight pipe, the new Naylor Low-Pressure Wedge-Lock coupling provides the fastest and most economical method of pipe connection yet devised. It is so simple that a hammer is the only tool required to connect or disconnect it. If you do not already have one of the new Naylor catalogs describing this development, write for your registered copy today.

Write for new Naylor Catalog No. 44

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NAYLOR PIPE COMPANY
General Office
1248 EAST 92ND STREET • CHICAGO 19, ILLINOIS
New York Office
350 Madison Avenue • New York 17, N. Y.

University of Texas, Bureau of Industrial Chemistry, were honored guests at a recent meeting of the Texas Society of Professional Engineers at Houston.

J. H. Irvine, of Ottawa, Ont., has recently been elected president of the Ottawa division of the Engineering Institute of Canada.

Col. D. W. Griffiths, district engineer at Galveston, Tex., was principal speaker at a recent meeting of the Texas Society of Professional Engineers at Houston.

Albert F. E. Horn, manager of the Washington office of the General Electric Co., was recently elected president of the Washington, D. C., Society of Engineers. He succeeds C. L. Garner, chief of the Division of Goedesy, U. S. Coast and Geodetic Survey. Other new officers elected are: C. A. Betts, vice-president; E. C. McKay, secretary, and B. F. Locraft, treasurer.

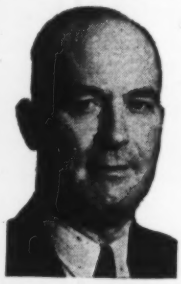
G. W. Brown of Saint John, N. B., has been elected president of the Association of Professional Engineers of New Brunswick.

William Adrian, structural engineer, was elected president of the Structural Engineers' Association of Northern California at its 16th annual meeting recently.

William Adrian

Wm. M. Moore was elected director and vice-president. The other new directors elected were Mark Falk and M. V. Pregnoff, while the hold-over director was Harold M. Engle.

Lewis A. Peacock, vice-president and general manager of Marine Contractors, Inc., has been elected president of the Portland, Ore., chapter, Associated General Contractors. Donald Hall of E. C. Hall Co. was elected first vice-president; Marshall Newport of Newport Construction Co., second vice-president, and Jack McDougall, Natt McDougall Co., to serve as secretary-treasurer.



L. A. Peacock

Named as directors are: J. C. Compton, G. E. Kibbe, H. A. Kuckenberg, G. W. Lind, M. J. Lynch, Frank Lyons, A. B. McEachern, E. A. Schram and H. F. Slate.

Manufacturers' Activities

MAJ. VICTOR T. NYDELE formerly of the Corps of Engineers, U. S. Army, has been appointed the mid-western division manager of the Luria Engineering Corp., airport and industrial specialists, with offices in Chicago, Ill. Prior to his service with the Aviation Engineers, both in the United States and overseas, he was an engineer and constructor in the middle West for about twenty years.

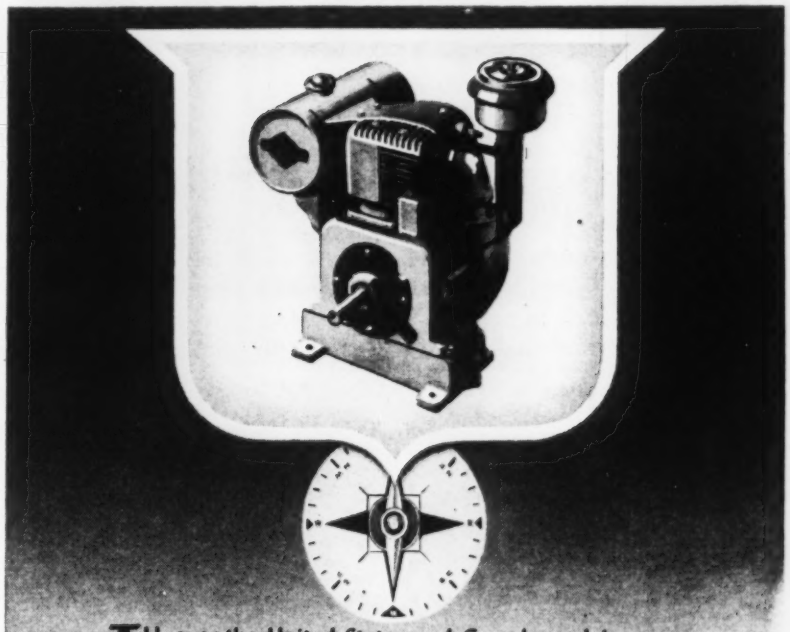
MAJ. H. BERKEY BISHOP has been appointed general manager of Kotal Co. of Summit, N. J. He has just served for four years as executive officer of the Southwestern Proving Ground of the Army Ordnance Department at Hope, Ark. He was graduated in 1937 from the Massachusetts Institute of Technology. Prior to entering the Army, he was superintendent of the plastics department of the Vulcanized Rubber Co., Morrisville, Pa.

Charles H. Welling of Charles H. Welling & Co., Inc., industrial consultants of New York, who has acted as general manager of Kotal Co., will continue active in the business and in other enterprises with Howard B. Bishop.

THE DIRECTORS of the Great Lakes Supply Corp., equipment distributors, Chicago, Ill., have announced the appointment of William R. O'Brien as vice-president, equipment division, and Louis P. Tiernan, as manager of sales, equipment.

THE EDWARD VALVE & MFG. CO., INC., East Chicago, Ind., has been renamed Edward Valves, Inc. The company, which manufactures cast and forged steel valves, is a subsidiary of the Rockwell Manufacturing Co. In announcing the change, Willard F. Rockwell, chairman and president of the Rockwell Manufacturing Co., emphasized that the change in name was a matter of simplification for marketing

ONLY BRIGGS & STRATTON OFFERS THIS COMPLETE WIDE-SPREAD SERVICE



ALL over the United States and Canada, and in many other countries, you will find Briggs & Stratton *Authorized Service Stations.* Operating under factory policies and procedures, they are again becoming fully equipped to take care of any emergency—to adjust, repair, or rebuild any model of Briggs & Stratton engines, even though it is a veteran of ten or twenty years of service. This authorized service is maintained to protect your investment in Briggs & Stratton engines. It is an important *added advantage,* recognized alike by manufacturers, dealers, and users of appliances, farm machinery and industrial equipment.

BRIGGS & STRATTON CORP., MILWAUKEE 1, WIS., U.S.A.

Air-Cooled Power

4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

When conditions are

STEAM SWEAT or SOAK

USE WOLMANIZED LUMBER*

Why? Because this lumber, impregnated with Wolman Salts* preservative by pressure treatment, will give you more years of service in places where rot-producing moisture is present.

It is recommended for use in structures exposed to:

1 Moisture in artificially humidified buildings.

2 Steam and vapor from industrial processes.

3 Condensed water vapor in walls, floors and ceilings of refrigerated buildings.

4 Soil moisture and rainwater, held in joints, etc., of outdoor structures.

5 Moisture condensed by concrete or masonry.

When you buy treated lumber, remember to specify ***pressure-treated*** . . . it's the only dependable kind!

AMERICAN LUMBER & TREATING COMPANY

CREOSOTING

*Registered trademarks

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1649 McCORMICK BUILDING, CHICAGO 4, ILLINOIS

purposes and that no change in personnel or sales policies is planned. W. F. Crawford continues as president of Edward Valves, Inc.

FISHER IRON & METAL CO. has announced that it has changed its corporate name to Fisher Steel & Supply Co. as more appropriately descriptive than the former name. There will be no change in the personnel, policies or finances of the company, which will continue at Muskegon, Mich.

H. E. McPHERSON, of Cleveland, Ohio, has been appointed assistant manager of sales for Republic Steel Corp's Union Drawn Steel division at Massillon, Ohio. Since joining Union Drawn Steel in 1928, he has worked at sales offices in Indianapolis, Cleveland, Los Angeles and Detroit.

E. B. POOL, for ten years a mechanical and experimental engineer with Chrysler Corp., will conduct a new type of value research work for Edward Valves, Inc., East Chicago, Ind.

He will specialize in stress and strain experiments and pioneering investigations in flow characteristics and pressure drop, besides other mechanical and metallurgical research work. During the war he was in charge of the physical testing laboratories and material and process standards at the Dodge-Chicago plant, operated by Chrysler. He is a graduate of Princeton.

THOMPSON MATERIALS CORP., Belleville, N. J., has been appointed distributor in New York, New Jersey and New England for corrugated and sheet asbestos made by the Keasbey & Mattison Co., Ambler, Pa.

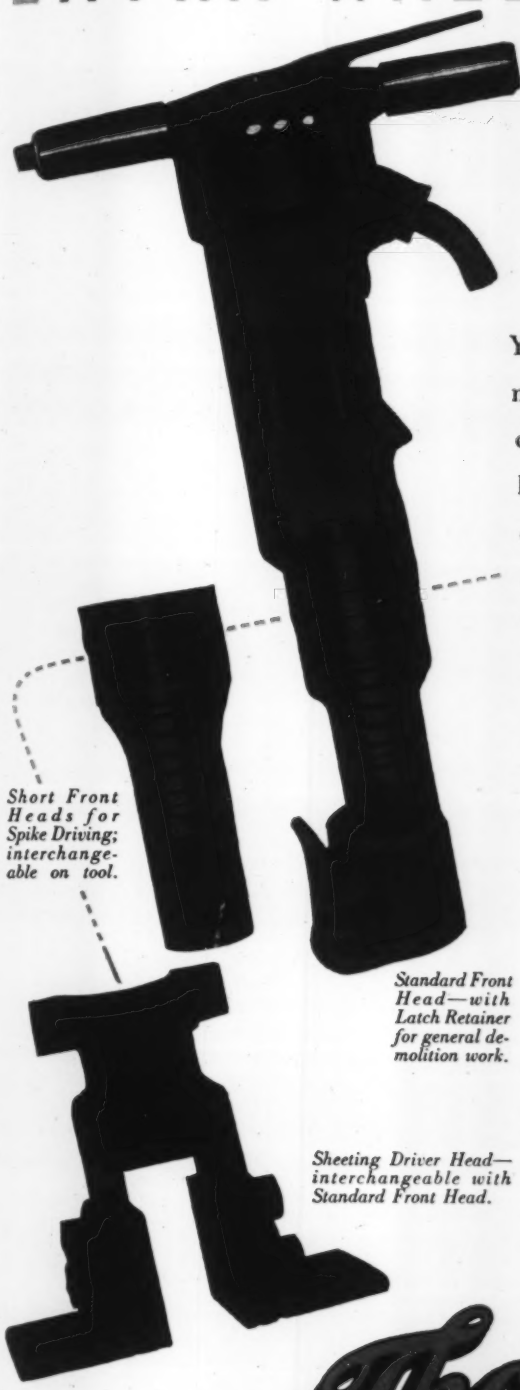
CARNEGIE-ILLINOIS STEEL CORP., U. S. Steel Corp., subsidiary, has announced the following sales appointments: John R. Johnston has been appointed manager of the Milwaukee district sales office. He first became associated with the subsidiary company in 1925 following graduation from the University of Illinois. He served in various capacities until 1938 when he became assistant manager of the Chicago district sales office. John H. Morava has been appointed assistant manager of sales in the Chicago district office succeeding Mr. Johnston. He holds a master's degree from Yale University and has been associated with the company since 1930. In the war he served as lieutenant colonel in the 309th Engineering Battalion.

Howard J. Mullin is appointed assist-

EXTRA WALLOP *for Faster* { BREAKING / SHEETING DRIVING / SPIKE DRIVING

with Thor

PAVING BREAKERS



Short Front Heads for Spike Driving; interchangeable on tool.

Standard Front Head—with Latch Retainer for general demolition work.

Sheeting Driver Head—interchangeable with Standard Front Head.

YOU CAN USE the extra power of Thor Paving Breakers to do many *different* jobs. As hard-hitting demolition tools they break concrete, rock and ice; cut asphalt; tamp dirt; dig clay and hard pan. Used with Sheeting Driver attachment, they quickly drive wood or steel sheeting as thick as 3 inches. Another simple change of the front head and they become heavy-duty Spike Drivers.

EXTRA POWER Speeds the Work

On *every* job, Thor Breakers are bonus makers. Thor's exclusive short-travel, tubular valve gets more work from *all* the air to drive a reversible, block-type piston in harder blows. Air cushioning of the piston in the cylinder—plus perfect timing and balance—provide smooth operation for easy handling. Air vents in the sturdy back head keep the handle remarkably cool. Rugged construction means long-life and low maintenance cost. You can get these benefits on your own jobs now . . . ask your nearby Thor distributor.

INDEPENDENT PNEUMATIC TOOL COMPANY
600 W. Jackson Blvd., Chicago 6, Illinois

Birmingham Boston Buffalo Cleveland Detroit Los Angeles Milwaukee New York Philadelphia
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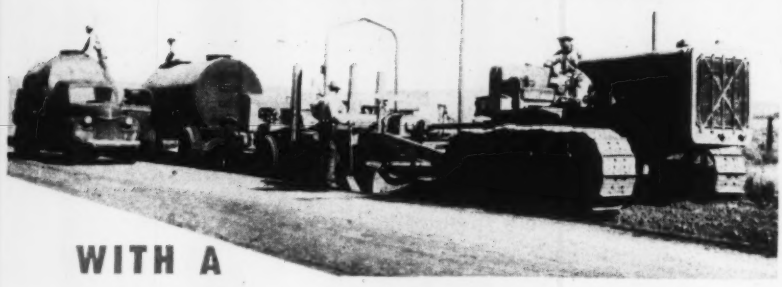
Thor PORTABLE POWER TOOLS

PNEUMATIC TOOLS • UNIVERSAL AND HIGH FREQUENCY ELECTRIC TOOLS • MINING AND CONTRACTORS TOOLS

YOUR MIX-IN-PLACE JOBS ARE DONE FASTER at LESS COST



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WOOD ROADMIXER

Here's why...

First: Lower costs per square yard or ton than any other method.

Second: Higher production, as much as 250 tons per hour of ready-to-spread mix.

Third: Two men can handle an average job.

Fourth: Only a tractor and supply truck are needed as auxiliary equipment, which can be used for other work when Roadmixer is not in use.

Fifth: First cost, operating and maintenance costs are less than for similar equipment.

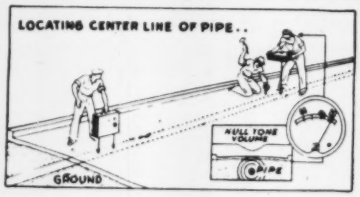
Sixth: 14 years of user operation the world over prove its economy and long life.

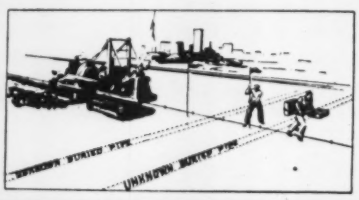
Wood Roadmixers are now available for immediate delivery—see your local distributor or write direct for prices and literature. 1-B

ROADBUILDING EQUIPMENT

WOOD MANUFACTURING CO.

BOX 620, 6900 TUJUNGA AVENUE • NORTH HOLLYWOOD, CALIFORNIA





M-SCOPE

BURIED PIPE AND CABLE FINDER

16 PAGE BOOKLET FREE UPON REQUEST

FISHER RESEARCH LABORATORY

Palo Alto, California

ant manager of the St. Louis district sales office. He is a Dartmouth graduate and first joined the company in 1927.

John A. English, Jr. leaves the position of assistant manager of railroad material sales in the Chicago district to become assistant manager of Detroit district sales. He is a Carnegie Tech graduate and began with the company in 1930.

Edward W. Backes succeeds Mr. English as assistant manager of sales for railroad materials in Chicago. He finished Yale University graduate school in 1922. He began his career with Carnegie-Illinois in 1940.

RAYMOND CONCRETE PILE CO. has elected Maxwell M. Upson chairman of the board and William V. McMenimen president, succeeding Mr. Upson, who has been with the company since 1907, as general manager and president since 1931. He now assumes the post formerly held by Morton D. Hull, one of the founders.

M. M. Upson

Mr. McMenimen has been associated with the Raymond Concrete Pile Co. since 1911 and has been vice-president and general manager since 1931.

Other executive changes were the appointment of Henry C. Boschen, previously project manager, as vice-president and director; George F. Ferris, formerly vice-president of the Turner Construction Co. as vice-president and general manager; and Rear-Admiral Kirby Smith as sales manager, upon his return from service in the Bureau of Yards and Docks in Washington, D. C.

The Raymond Concrete Pile Co., founded in 1897, is an extensive contractor for government work in South America and Asia, as well as in the United States. It is also responsible for the foundations of many of the largest buildings. The company was a major member of Contractors, Pacific Naval Air Bases, which carried out an extensive construction program for the United States Navy, the largest single construction contract ever awarded by the United States.

W. V. McMenimen

LYNN SAWYER, general manager of the pump division of the Byron Jackson Co., has been elected a vice-president. Formerly chief engineer of the Roosevelt Water Conservation District, Ari-

(Reproduction of advertisement appearing in Fortune Magazine)

for THE MEN WHO "Button Up" THE SINEWS OF INDUSTRY

To men on location who must rivet or weld the sinews of industry according to details of the building layout, Allied offers help, as well as to the architects and engineers who design the structures.

Many fabricating and erection short-cuts have been learned during war years, and Allied engineers are glad to co-operate in interpreting plans quickly and in super-fast assembly of precision units fabricated for the job.

This Allied experience working in harmony with contractors and engineers can but result in economies wherever steel structures rise. Let Allied team with you in fabricating and erecting the steel for your buildings.

ALLIED STRUCTURAL STEEL COMPANIES

ENGINEERS
FABRICATORS (75,000 TONS CAPACITY)
ERECTORS

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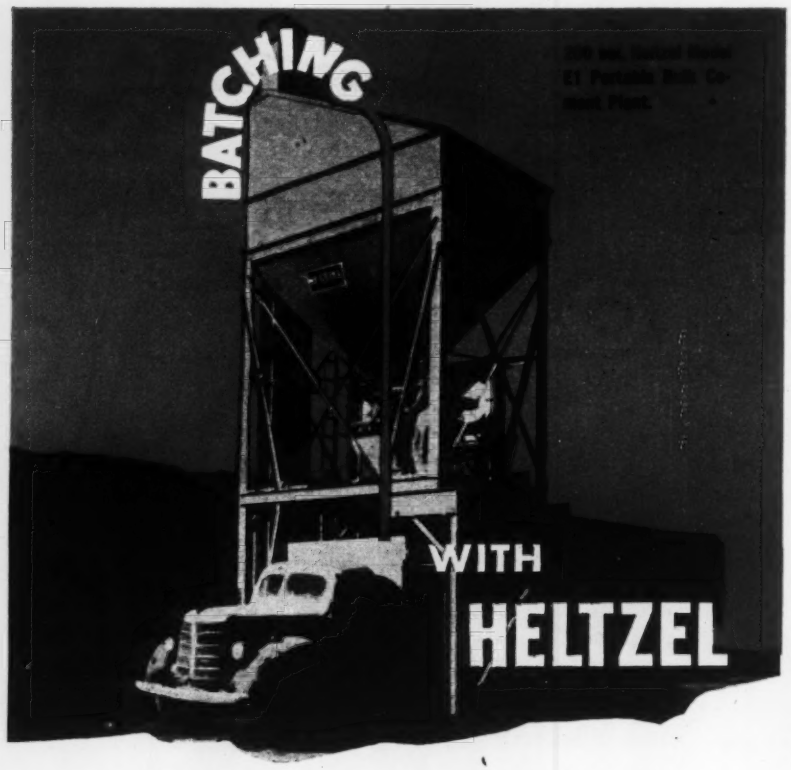
- GAGE STRUCTURAL STEEL CO., 3123-41 S. Hoyne Ave., Chicago 8, Ill.
- MIDLAND STRUCTURAL STEEL CO., 1300-20 S. 54th Ave., Cicero 50, Ill.



One-Man Operation
Accurate Batching
Uniform Flow with Heltzel Tubular Valve
Easily Accessible

Accurate batching any given proportion day after day, year in and year out, often means the difference between profit and loss to you.

Heltzel, in business for 34 years, manufactures equipment for any style of bulk cement operation, as exemplified by these major Heltzel products:

Portable Bulk Cement Plants
Portable Aggregate Batching Plants
Truck Mixer Batching Plants
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Concrete Products Plants

Check with your Heltzel distributor or send in the coupon for factual bulletins:

C-36 Bulk Cement Plants
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HELTZEL STEEL FORM & IRON CO. WARREN, OHIO · U.S.A.

Heltzel
BUILDS IT BETTER

BINS, Portable and Stationary
CEMENT BINS, Portable and Stationary
CENTRAL MIXING PLANTS
BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
BITUMINOUS PAVING FORMS
ROAD FORMS (with lip curb and integral curb attachments)
CURB FORMS
CURB AND GUTTER FORMS
SIDEWALK FORMS
SEWER AND TUNNEL FORMS
CONCRETE BUCKETS
SUBGRADE TESTERS
SUBGRADE PLANERS
TOOL BOXES
FINISHING TOOLS FOR CONCRETE ROADS

zona, Sawyer joined Byron Jackson Co. in 1929 as a salesman in the San Francisco Bay area. He was made manager of the Mid Continent division at Fort Worth, Tex., in 1933, and of the New York office in 1938. In November, 1943, he was recalled to the head office and promoted to general manager of the pump division.

EXPANSION of the research program of the gypsum industry has been initiated with the appointment of Lieut. Chester Abbey, U.S.N.R., as research engineer of the Gypsum Association. The industry expects to contribute greatly to expand building activity and to fit its old products into the construction program, as well as to seek and perfect new building products.

Lieut. Abbey, who received his degree in civil engineering at Washington University, in 1932, was with the James Stewart Corp., Chicago, from 1941 to 1943 as field engineer, assistant superintendent, and office engineer on major construction projects.

From 1934 to 1938, he was assistant civil engineer with the Water Department, St. Louis, Mo., helping to install 21 miles of steel water conduits. He also served with the Office of the Quartermaster General of the U. S. Army in the expansion program at Scott Field near Bellville, Ill., which included new buildings, water supply, and drainage, and with the Construction Division of the O.Q.M.G. at Washington.

JAMES FERGUSON, long associated with the General Box Co., as sales and production manager of the Kansas City office, has been promoted to sales manager. Located in Chicago, he will work with N. A. Fowler, director of sales and research.

Mr. Ferguson began in the packaging industry with the Continental Box Co., Houston, Tex., later a division of General Box. There, he not only was connected with selling, but also with the cost and accounting department. While in Kansas City, Mr. Ferguson was placed in charge of sales, and later took on the additional responsibilities of production.

J. H. WALSH, vice-president in charge of steel works, Inland Steel Co., has retired from active service, remaining as a

STANDARD ENGINEERS NOTEBOOK

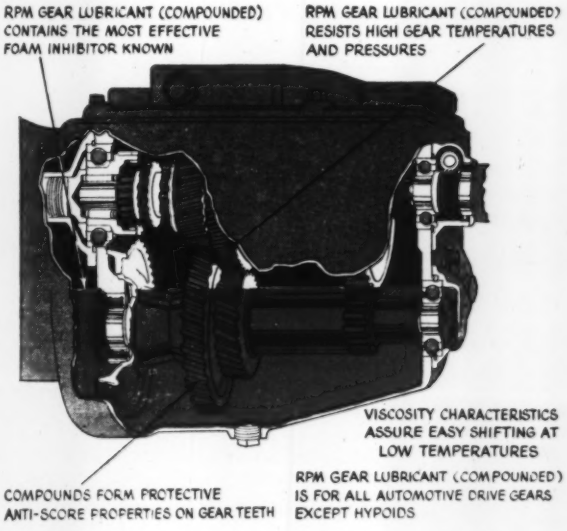
Compounded lubricant prevents gear scoring

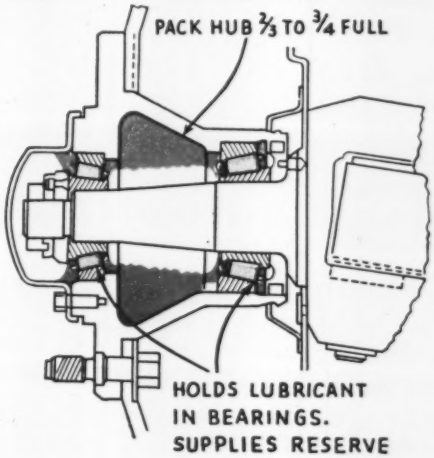
Many operators of automotive equipment have eliminated transmission and differential trouble by switching to RPM Gear Lubricant (Compounded). It is recommended for all transmissions and all conventional differentials. (RPM Hypoid Lubricant should be used in hypoid differentials.)

The compounds in RPM Gear Lubricant assure that a tough, oily film will remain on gears when pressure and heat become excessive. A highly effective foam inhibitor prevents retention of air in lubricant, poor distribution and "boiling up" to cause leaks.

RPM Gear Lubricant (Compounded) is non-corrosive. It comes in four grades: SAE 80, 90, 140, 250.

For complete information about automotive drive gears and their lubricants, write for the new, free booklet: "The Lubrication of Automotive Gears."


RPM GEAR LUBRICANT (COMPOUNDED) CONTAINS THE MOST EFFECTIVE FOAM INHIBITOR KNOWN
RPM GEAR LUBRICANT (COMPOUNDED) RESISTS HIGH GEAR TEMPERATURES AND PRESSURES
VISCOSITY CHARACTERISTICS ASSURE EASY SHIFTING AT LOW TEMPERATURES
RPM GEAR LUBRICANT (COMPOUNDED) IS FOR ALL AUTOMOTIVE DRIVE GEARS EXCEPT HYPOIDS
COMPOUNDS FORM PROTECTIVE ANTI-SCORE PROPERTIES ON GEAR TEETH



Wheel bearings last with heat-resistant grease

Because RPM Wheel Bearing Grease absorbs the countless shocks on wheel bearings, and stays put in extreme temperatures, it will prolong the life of properly adjusted wheel bearings.

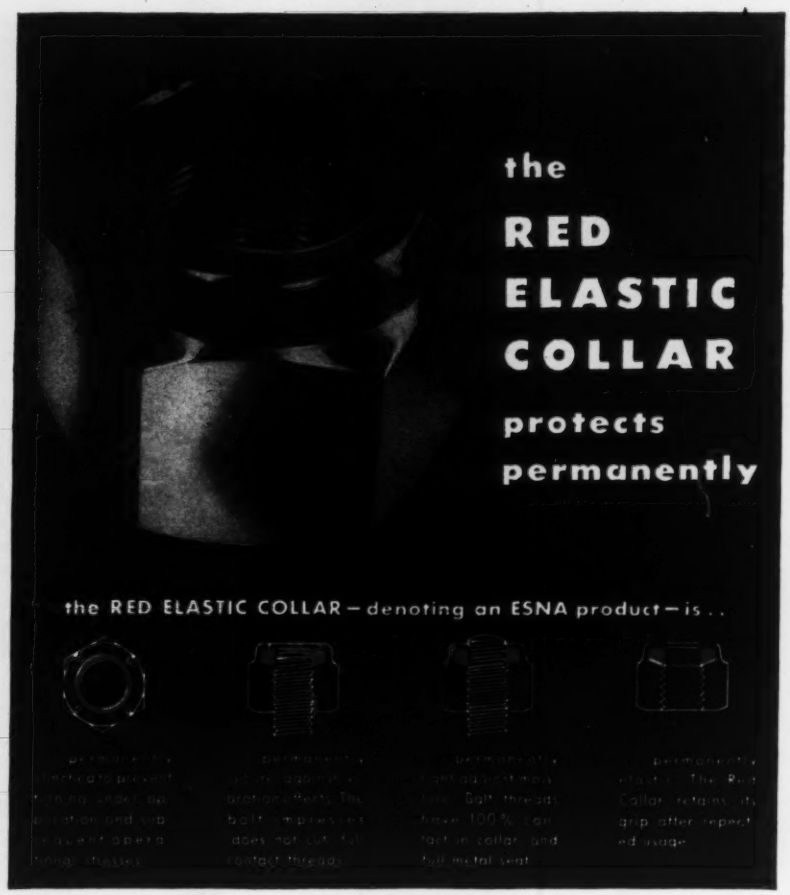
RPM Wheel Bearing Grease is specially made for wheel bearings — both the roller type and the ball type. It will not throw out and melt unduly even in hot weather. In any weather it feeds in the proper amounts onto all parts of bearings providing a uniform, tough lubricant film. The resiliency of this film reduces vibration that might rack wheel bearings and steering gear assemblies.

Water resistant, RPM Wheel Bearing Grease helps bearing seals keep out moisture. It seals out grit and dust, too.

For complete information, write for the free booklets, "How To Service and Lubricate Wheel Bearings." There's one for heavy-duty trucks and trailers and one for light equipment.

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif.; The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.; The California Company, 17th and Stout Streets, Denver 1, Col.; Standard Oil Company of Texas, El Paso, Texas.

FOR EVERY JOB A **STANDARD OF CALIFORNIA** TEST-PROVED PRODUCT



What happens when this Red Elastic Collar becomes part of a nut? The nut becomes an ESNA Elastic Stop Nut! And it provides permanent protection for any detachable or adjustable assembly.

How?

First, an Elastic Stop Nut *locks in position anywhere on a bolt or stud.* Every bolt can be precisely prestressed to carry its full load. Positioning devices can be adjusted with precision. Vibration cannot disturb these settings – because the Red Elastic Collar eliminates all play between bolt and nut threads with its full contact, permanent grip.

Second, it *prevents thread corrosion.* Moisture is sealed out. Adjustment or removal is easy – any time.

Third, it *prevents thread damage.* Full thread contact in the Red Elastic Collar keeps the metal threads firmly seated. Axial play caused by vibration or stress reversal is dampened.

Fourth, it *prevents seepage of liquids past bolt threads.* Permits nut to be used as a sealing device.

Fifth, it *prevents maintenance waste.* The Red Elastic Collar, which does not injure the bolt or its plating, permits repeated usage.

Here's a challenge: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts – FREE, in experimental quantities. Or, if you want further information write for literature. Elastic Stop Nut Corporation of America, Union, New Jersey. Representatives and Agents in principal cities.

ESNA

ELASTIC STOP NUTS

INTERNAL WRENCHING · ANCHOR · INSTRUMENT MOUNTING · SPLINE · CLINCH · GANG CHANNEL

PRODUCTS OF: **ELASTIC STOP NUT CORPORATION OF AMERICA**

director. He was formerly superintendent of rolling mills in the old South Chicago Works of Illinois Steel Co. He has been with Inland for 23 years and has a remarkable record for high production of good quality steel.

Fred M. Gillies, who has held the position of general superintendent of the Indiana Harbor Plant, becomes works manager. Mr. Gillies studied mechanical engineering at Cornell University, leaving to become a naval aviator in World War I. His steel career began in 1910. He worked during summer vacations at the South Chicago works of the Illinois Steel Co. After the war he returned to Illinois but in 1922 went to Inland Steel as superintendent of the 100-in. plate mill. He was assistant general superintendent from 1930 to 1939 and in 1939 became general superintendent.

A. P. Miller, who has been assistant to the general superintendent of the Indiana Harbor plant, becomes general superintendent. He was graduated in mechanical engineering from the University of Pittsburgh.

A. J. Cochrane, who has been in charge of the 19-in, 24-in and 36-in mills, will become assistant general superintendent. Mr. Cochrane attended Western Reserve University in Cleveland. He worked for the American Steel and Wire Co. and went to Inland in 1928.

W. A. Perry, who has been superintendent of the electrical and power departments, will become assistant to the general superintendent. Mr. Perry has been with Inland for 35 years.

H. W. Johnson, who has been assistant general superintendent of the Indiana Harbor plant, has been appointed staff assistant to the president, Wilfred Sykes. Mr. Johnson was graduated from the University of Illinois, with a bachelor of science degree, and began work in the Joliet plant of Carnegie-Illinois Steel Corp. He went to Inland in 1929 as assistant superintendent of blast furnaces. In 1930 he became superintendent of blast furnaces. In 1942 he was made assistant general superintendent.

SHIFTING from war engineering and construction to that of peacetime, the engineering department of the Du Pont Co. has announced extensive realignment of its organization. Among the appointments announced by E. G. Ackart, chief engineer, were: T. C. Gary, manager, design division, becomes department engineer, reporting to Granville M. Reed, assistant chief engineer; M. F. Wood, manager of the construction division, becomes manager of the design division; F. H. Mackie, manager of construction of government plants for war production, becomes manager of the construction division; G. P. Church, field project manager of the Hanford Engineer Works, Richland,

Wash., a major production unit of the government's atomic energy project, becomes assistant manager of the construction division, and O. R. Ames, manager of general construction, has been appointed a special assistant to Mr. Mackie.

Du Pont's construction program for peacetime production already exceeds $40,000,000 in projects publicly announced thus far for various parts of the country.

ALBERT A. FRANK has been appointed vice-president of Great American Industries, Inc., and general manager of Ward LaFrance Truck Division, Elmira, N. Y., manufacturers of commercial motor trucks, fire apparatus, etc. A. Ward LaFrance, founder, has announced his retirement from active management of the division. He will remain as vice-president of Great American Industries, Inc., and a member of the board of directors.

In 1921 Mr. Frank started in the automotive industry with the Rickenbacker Motor Co., in Detroit, Mich. In 1925 he joined the Chrysler Corp. Progressively, he participated in various divisional accounting, manufacturing and sales activities, and for several years was second in command of the Chrysler Motor Parts Corp. In 1943 Mr. Frank joined Ward LaFrance as sales manager, and during the war had charge of all the division's contractual relations with the War Department.

Other executive appointments include E. M. Hoefle, general sales manager; C. W. Wiley, domestic sales manager; R. L. Harmon, export sales manager; N. G. Bjorck, chief engineer; R. L. Moody, factory manager and R. M. Bingham, production superintendent.

FRED REISER, JR., Cincinnati district manager for the industrial division of The Timken Roller Bearing Co. since 1944, has been named division manager for all divisions of the company there, including industrial, steel, automotive, and service-sales. Starting in 1933 with the industrial engineering department, Reiser was sent to Pittsburgh in 1935, as a sales engineer. He was transferred to Cincinnati in 1941. He attended Columbia University and New York University, before returning to the University of Pittsburgh to receive his bachelor of science degree in mechanical engineering in 1932. He served as an instructor in mechanical engineering at the University of Pittsburgh for one year before starting with Timken.

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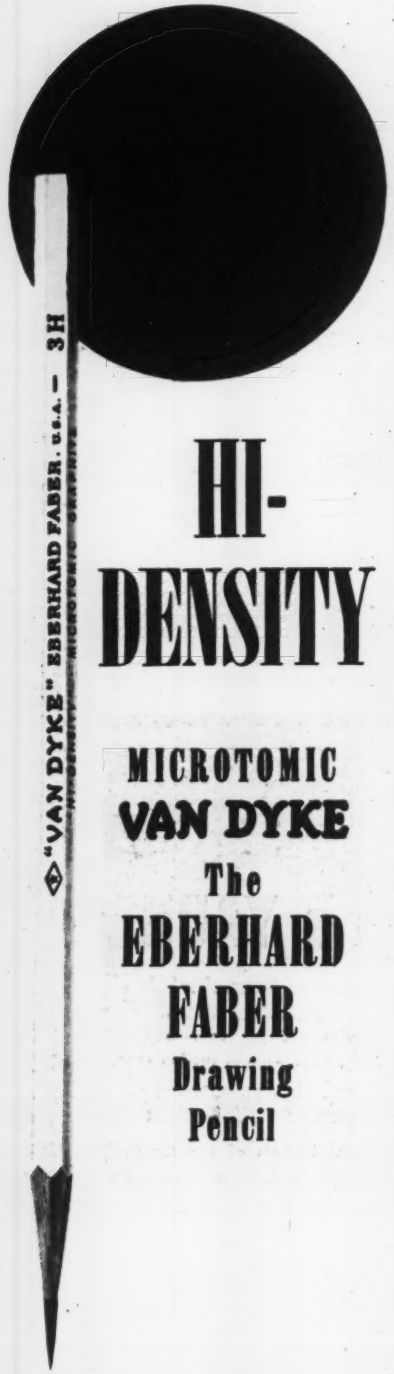

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naturally follow when you switch over to the HI-DENSITY lead of MICROTOMIC "VAN DYKE" pencils. The HI-DENSITY lines are measurably more opaque — print more cleanly. Try a "Van Dyke", and discover the drawing pencil with the quality touch. Your choice of 18 degrees.

Also in six degrees special chisel-point leads.

MEN AND JOBS

R. W. Hebard & Co., New York engineering and construction firm, has announced the appointment of D. H. McNeal as vice president and director. Mr. McNeal served for 4 years as assistant president of James Stewart & Co., builder of the New York Central Building in New York, Republic Steel Corp.'s $100,000,000 plant in Chicago, the United States Navy Base in Trinidad, and other important structures. Mr. McNeal, a prominent figure in the building industry for more than 25 years, has been in charge of many important construction projects in the United States and in South America. Before his association with the Stewart firm Mr. McNeal was for eight years Technical Director for the Federal Home Loan Board and Deputy General Manager for Home Owners Loan Corporation in Washington for which he organized and directed all construction and appraisal work throughout the country.

R. W. Hebard & Co. is an international engineering and construction concern, operating principally in Latin America. It started about 40 years ago and its first work was on the Panama Canal. Other operations include the first railroad built in Panama, Salvador-Guatemala Railroad, a system of national highways for Panama, Colombia and Paraguay, and the water works system in Lisbon, Portugal. The company is also in the industrial and commercial building field. Leading engineers and builders of South America are associated with it in this work.

Brig. Gen. John J. Kingman, Washington, D. C., and **Maj. Harry F. Kirkpatrick,** Springfield, Mo., both Engineer officers, have been awarded the Legion of Merit. General Kingman received his medal for "exceptionally meritorious conduct in the performance of outstanding services as Assistant Chief of Engineers from February, 1938, to November, 1941." During this period he served as chief of the military division, Office of the Chief of Engineers, and was in charge of the personnel, intelligence, supply, operations and training and fortifications sections of this activity.

Major Kirkpatrick's award was for "exceptionally meritorious conduct in the performance of outstanding services as chief engineer, Advance Section No. 1, and chief engineer, Advance Section No. 3, Services of Supply, United States Army Forces, China-Burma-India Theater, March 15, 1943, to June 30, 1944.

New engineer members of the staff of the National Research Council are **George A. Rahn,** engineer of materials; **Alfred W. Johnson,** engineer of soils and foundations; and **Franklin N. Wray,** engineer of design.

Mr. Rahn, for 25 years with the Pennsylvania Department of Highways, studied civil engineering at the University of Pennsylvania. After two years with the U. S. Engineers, A.E.F., he joined the Pennsylvania State Highway Department in 1919.

Mr. Johnson was educated at Kansas State College and got his first experience in highway work with the Kansas Highway Commission from 1931 to 1940, as materials inspector and soils engineer on soil surveys, testing, design and research. Since 1942 he has been with the Highways and Municipal Bureau of the Portland Cement Association.

Mr. Wray's extensive highway experience was gained through 15 years with the Missouri State Highway Commission. In the war, he was with the U. S. Engineer Department, in charge of the military access road program in the Mobile district, directing material surveys and assisting in planning the St. Lawrence River project, serving as assistant area engineer on airfield and war plant construction at Cleveland and working on plans, specifications and research in the Office of Chief of Engineers.

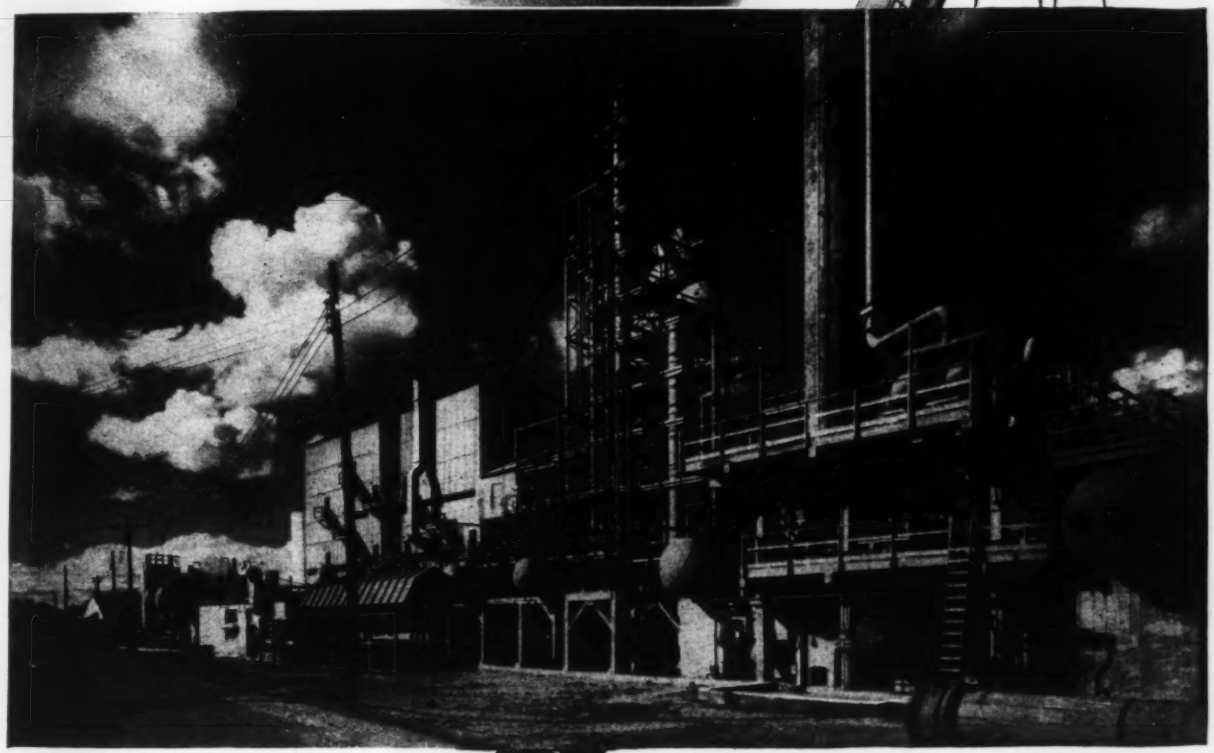
E. W. Clark, formerly chief of the War Projects Unit of the Bureau of the Budget, now abolished, has retired from government service. He had been executive assistant to the Deputy Administrator of the Public Works Administration. He was later commissioner of the PWA. In 1940 he became chief of the War Projects Unit which he helped organize. During its five years this unit made about 9000 reports on the construction, production, and operation of the various government agencies engaged in the war effort.

John F. Daniel, city engineer of Panama City, Fla., has been appointed city manager.

F. F. Kravath, comdr. (CEC) USNR, is public works officer at the Naval air station, Coco Solo, Canal Zone. A graduate of Drexel Institute of Technology, he was formerly assistant proving grounds officer at Davisville, R. I., and prior to that executive officer of the 138th Naval construction battalion at Attu, Alaska.

RUBBER PLANTATION—AMERICAN STYLE

The only three butyl rubber plants in existence . . . those at Baton Rouge, Louisiana; Baytown, Texas; and Sarnia, Ontario . . . were engineered and built by Stone & Webster Engineering Corporation. In view of the many specialists required for each plant's design, erection and ultimate operation, we also acted as the coordinating agency.



Pictured above, unit #2, butyl rubber plant, Baton Rouge, Louisiana, operated by Standard Oil of New Jersey (Louisiana Division). Largest and first to go into operation; design capacity is 33,000 long tons of butyl rubber per year.

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"You can pass a dollar through a pinhole!"

"You don't have to be a magician either... just unwise... for it happens every time you have a leaking pipe joint! There are dollars passing through these leaks... and they might be your dollars!

"This chart shows how much leaks can cost you...

SIZE OF OPENING	AIR 100 Lbs. Pressure		GASOLINE 15 Lbs. Pressure		WATER 40 Lbs. Pressure	
	Cu. Ft. Wasted Per Month	Cost at 10c Per M	Gal. Wasted Per Month	Cost at 4c Per Gal.	Gal. Wasted Per Month	Cost at 15½c Per M
3/8"	9,979,200	$997.92	423,000	$16,920.00	692,400	$108.00
1/4"	4,449,600	444.96	188,000	7,520.00	307,700	48.00
1/8"	1,114,560	111.48	47,100	1,884.00	76,900	12.00
1/16"	278,640	27.88	11,800	472.00	19,200	3.00

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Before the war he had been a mechanical designer with the Panama Canal.

P. M. Feltham of the Veterans' Administration has been appointed director of construction and supply services for veterans' hospitals in Georgia, Florida, Alabama, South Carolina and Tennessee, with headquarters at Atlanta, Ga.

Raphael G. Kazmann, formerly associate engineer with the ground water division of the U. S. Geological Survey, has joined the technical staff of Ronney Method Water Supplies, Inc., Louisville, Ky. as hydrologic engineer.

DISTRICT ENGINEER OFFICERS

Lt. Col. R. W. Sauer, district engineer of the Vicksburg District, U. S. Army Engineers, for the last three years, has been awarded the Legion of Merit for his outstanding activities in flood control work and maintenance of navigation channels on the Mississippi River during the war emergency.

Col. Rufus W. Putnam, U. S. District Engineer at Los Angeles, is retiring from the service and will resume civilian engineering work. He became head of the office in July, 1942. Colonel Putnam has directed approximately 5,700 employees of the district, which includes southern California, Arizona and the Colorado River Basin, extending into parts of Wyoming, Colorado, Utah, Nevada, and New Mexico. He supervised $700,000,000 worth of wartime construction.

Before going to Los Angeles, Colonel Putnam was district engineer of the Chicago Harbor and River district. His "Harbor Plan of Chicago" report, completed in 1927, has formed a basis for all succeeding harbor planning for that city. **Col. Robert C. Hunter,** formerly the Sacramento, Calif., district engineer, will take Colonel Putnam's place in the Los Angeles district.

Col. Jesse H. Veal has been appointed chief, engineering division, of the San Francisco District Office, replacing **H. S. Pond,** who is retiring after more than 30 years.

During the early stages of defense construction in 1939, Colonel Veal was constructing quartermaster at Fort Mason, and in December, 1941, was assigned to the San Francisco Engineer District and placed in charge of local construction. After leaving that installation in December, 1942, Colonel Veal assumed the duties of District Engineer at Cincinnati, Ohio, and subsequently at Louisville, Ky. Just prior to his return assignment in San Francisco, he was executive officer of the North Atlantic Division Office.

"Progress forgot my address"...

"I hear a man can fly half-way across the country nowadays in four hours. Funny . . . it takes me almost that long sometimes to haul my crops twenty miles to the railroad siding. Nasty weather I can't get there at all—the road's that bad. Progress? Sometimes I wonder . . ."

Maybe you've wondered, too, about the condition of America's country roads. These roads—2,400,000 miles of them—serve 6,000,000 farms. They link rural Americans with their schools, churches, markets, neighbors. Yet, more than half of them have no surfacing of any kind, and over one-third are still classed as *primitive*.

True progress calls for planned maintenance and improvement of this vital road network. Barrett Tarvia*, a serviceable and economical road tar, can help—as it has helped in the past. Why not discuss your road problems with the Tarvia field man?

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Back to civilian activity

E. B. Cavallo, on military leave from the Mississippi State Highway department is back as construction engineer.

Lee B. Brandon, major, has returned as county engineer of Lauderdale Co., Miss., after Army service.

Arthur K. Stellhorn, released from the Army, is Manitowoc, Wis., city planning engineer.

Joseph Abernathy, for almost 4 years a Seabee, has joined the staff of the Genisot Engineering Co., Rhinelander, Wis.

Harold O. Strombom, captain, Corps of Engineers, is assistant Skagit County engineer at Mount Vernon, Wash. He succeeds **L. J. Wright,** resigned.

Warren A. Gallop, major, has returned to the Wyoming State Highway Department as project engineer at Lusk, after 32 months with the Army Engineers on the Burma Road.

A. L. Putman, captain, Corps of Engineers, has returned to the Wyoming State Highway Department.

Jennings J. Bennett, formerly of the Navy, has been appointed assistant city engineer at Puyallup, Wash.

N. H. Barton, lieutenant commander, released from active naval duty, has joined Smith Associates, Inc., New York City, as vice-president in charge of construction.

James O. Hunter, recently discharged after 3 years in the Corps of Engineers in the Pacific, has been employed as state airport engineer in Missouri.

Lester G. Williams, major, Air Corps, is now a civil engineer for the Bureau of Reclamation at the San Luis Valley project, Monte Vista, Colo.

Ward E. Mathias, captain, Air Corps, has returned to his engineering work on the San Luis Valley project, Monte Vista, Colo.

John L. Baugh, lieutenant, USNR, is an engineer on the San Luis Valley project.

Edward F. Conrey, formerly with the Corps of Engineers, at Tulsa, Okla., is with the San Luis Valley project as soils technologist.

William W. Carlson, colonel, Corps of Engineers, is with Wm. W. Carlson & Associates, engineers, Cincinnati, Ohio.

It was erroneously stated in a recent issue that Basil Tuttle had been engaged as city engineer of Kenosha, Wis. on a temporary basis. There has been no change of personnel in that office.

Earl M. Kelly, recently in charge of a regiment of Seabees in the South Pacific as commander, CEC, USNR, with A. M. Kivari has announced the organization of Process Engineers, Inc., with offices in San Francisco and Los Angeles, Calif.

The Thompson & Lichtner Co., Inc., Boston, Mass., engineers, have appointed to their engineering division **Vincent K. Cates** of Melrose, Mass., engineer, recently commander, USNR of the 122nd Construction Battalion in the Philippines.

F. Paul Anderson, major, Corps of Engineers, is now production manager of Maule Industries, Miami and Ojus, Fla. He was formerly president of Ronald Taylor Co. of New York and later director of research for the Kentucky Highway Department.

Henry L. Doten, major, will return to the University of Maine as business manager. Formerly construction engineer for Maine state highways, he has been in the office of chief of engineering supplies, and of the training construction branch of the procurement division.

W. H. Webb, Jr., first lieutenant, Corps of Engineers, has returned as senior office engineer in the right-of-way department of the North Carolina State Highway and Public Works Commission, Raleigh, N. C.

Frank F. Bell, colonel, Corps of Engineers, has returned as vice-president of the Uvalde Construction Co., Dallas, Tex.

Colonel Bell's regiment carried out some of the most important construction tasks in the European Theatre of Operations, including the clearing and rebuilding of the ports of LeHavre and Rouen in France.

Samuel M. Cardone, East Lansing, Michigan, second lieutenant, Corps of Engineers, is back as research engineer for the Michigan State Highway Department.

H. B. Christianson, lieutenant colonel, Corps of Engineers, has been made assistant to the chief engineer of the Milwaukee R.R. at Chicago.

Ross E. Windom, colonel, Corps of Engineers, has become city manager of Sarasota, Fla.

Russell I. Boyce, after two years as structural engineer for the Corps of Engineers, U. S. Army, in the Mississippi River Commission at Vicksburg, has re-established a consultant practice at Wallingford, Conn., with his brother, **Newton Boyce,** first lieutenant, Air Corps.

Manufacturers' Publications

Welded Fabrication—An engineering manual discusses the factors affecting the choice of welded fabrication and the techniques of welded design. The factors are cost, weight, strength, appearance, stability, noise, quality, and delivery. Various types of welds are explained, as they affect static and fatigue load values.—*The United Welding Co., Middletown, Ohio.*

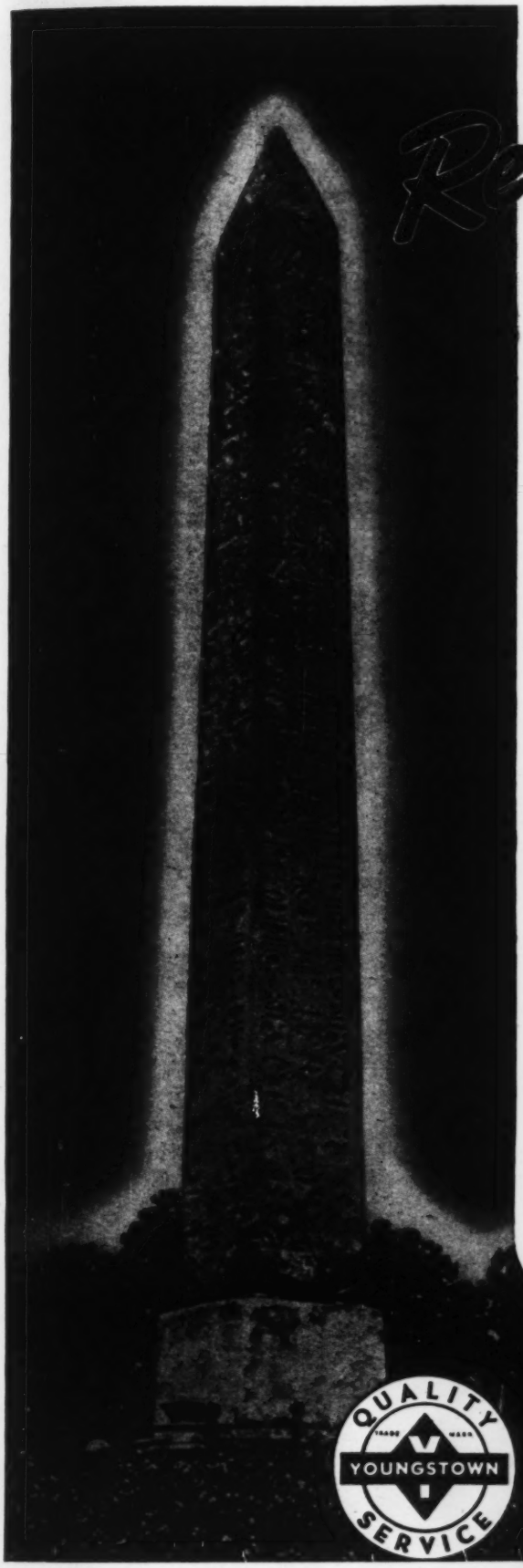
Clearing Dozer—The demands of clearing require a different technique than that of simple earthmoving, according to this manufacturer. A folder explains a method which it is said in some cases has reduced costs as much as 75 percent. The blade of the dozer has long, adjustable teeth which penetrate the ground as much as 21 inches and quickly remove rocks, roots, stumps and small trees without harming the top soil.—*Isaacson Iron Works, Seattle, Wash.*

Wire Rope Bulletins—A series of nine educational bulletins has been compiled to provide a reference index for industrial users of wire rope. The series illustrates the most efficient care and handling of wire rope to increase the service life of the rope and the machinery. The information should afford considerable savings in replacements and repairs.—*Union Wire Rope Corp., 21st and Manchester, Kansas City 3, Mo.*

Insulating Cement—A 4-page, fully-illustrated folder on insulating cement provides information, tables and charts on the efficiency, coverage and ease of application of the product, which is described as the all-purpose thermal insulation.—*Baldwin-Hill Co., 564 Klagg Avenue, Trenton 2, N. J.*

Water Analysis—A 44-page illustrated booklet presents various apparatus and chemicals used in industrial water analyses for plant control. It features the test sets required for hardness, alkalinity, phosphate, sulfate, dissolved oxygen, pH, silica and others. In addition, numerous comparators, photometers, turbidimeters, etc., are illustrated.— *W. H. & L. D. Betz, Gillingham and Worth Streets, Philadelphia 24, Pa.*

Diaphragm Pumps—An illustrated bulletin describes pumps which have these features: Non-clogging ball valves, quickly-accessible valve chambers, renewable valve seats, powerful steel walking beams, double bushings, long-life dia-



Record of a Past..

that knew no steel

ALMOST in the shadow of the world's tallest man-made structures stands this stone obelisk--"Cleopatra's Needle," in Central Park, New York. Its hieroglyphs boast of a glory that faded 3000 years ago.

If we deciphered these inscriptions, we would look in vain for the word Steel. Ancient Egypt hewed its monuments with tools of bronze. But bronze, then as now, was not plentiful enough to go far toward improving the lot of man.

What would our civilization be if we were deprived of steel? We might have monuments of stone, but no Radio City, no towering apartments or hotels, no modern hospitals, schools, or factories. For to sustain human life and human activity, we must have vast quantities of pure water and adequate sanitary facilities...from top floor to basement...provided only through miles of steel pipe. We must have quick, safe vertical transportation, possible only with steel elevators. We must have heating systems, production machines, equipment of a hundred kinds, available in the abundance which steel alone makes possible. In short, the difference between our civilization and that of the ancient world is expressed in terms of steel.

America stands on the threshold of a New Steel Age--with steels being given new characteristics and new virtues by metallurgists and chemists. Youngstown is ready to supply alloy steels as well as carbon steels--in sheets, tinplate, pipe, conduit, bars, wire, rods and shapes--to meet your needs in fabricating the products of peace.

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phragms, clamping rings which permit diaphragms to be replaced in only six to eight minutes, oversized pump bodies, extra heavy gearing and heavy-duty construction. They are for pumping water, mud, sand, ooze, slush, gumbo, slime, grit and liquids which contain large amounts of trash.—*Marlow Pumps, Ridgewood, N. J.*

Diesel Engines—Durability and versatility of performance of diesel engines in construction work are highlighted in a profusely illustrated 24-page color booklet. Action pictures portray endurance marks by machines, some of which are still serving after 15,000 to 50,000 heavy duty hours.—*Caterpillar Tractor Co., Peoria 8, Ill.*

Concrete Spreader—Features of a concrete paving spreader are described in a booklet. This spreader moves the concrete longitudinally and transversely at the same time automatically, regardless of where the concrete is placed on the subgrade. When the vibratory paving attachment is added the machine, operated by one man only not only spreads the concrete as required, but simultaneously consolidates and compacts it ready for the finishing machine operation.—*Blaw-Knox Co., Pittsburgh, Pa.*

Excavator—A detailed description of a 1½-yd. shovel and a 30-ton crane is in a catalog. Photographs illustrate operating advantages of the excavator, including the shovel boomfoot shock absorber, new improved shipper shaft design, ratchet dipper trip, pin-mounted dragline fairlead and the collapsible high A-frame raised and lowered by power. —*Koehring Co., 3026 W. Concordia Ave., Milwaukee 10, Wis.*

Hortonspheres—A booklet describes the reduction of evaporation losses from highly volatile liquids by storing them under pressure in spherical spheres called Hortonspheres. The correct storage pressure required to prevent standing losses from volatile liquids can be read directly from a chart shown. Included is a standard capacity table of the operating pressures available for each size. Gauging methods are described and photographs of three typical gauging units are shown.—*Chicago Bridge & Iron Co., 332 S. Michigan Blvd., Chicago 4, Ill.*

Crane—A 6-page folder presents on-the-job photographs of various crane applications ranging from an oil storage tank installation to culvert placing. A handy chart shows lifting capacities at various reaches. Also described is interchangeability with carryall scrapers, trucks, and trailers.—*R. G. LeTourneau, Inc., Peoria, Ill.*